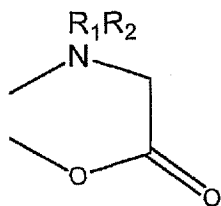
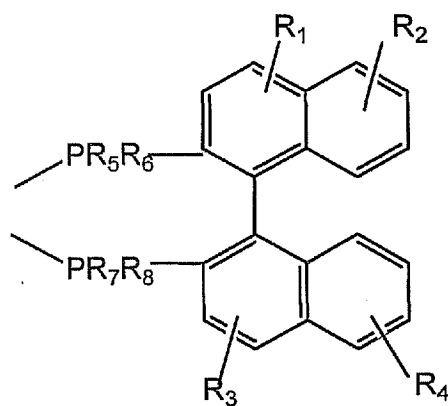
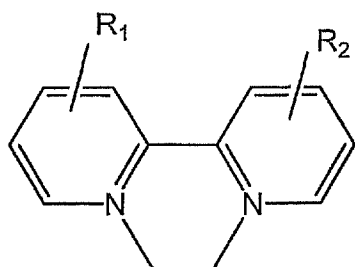
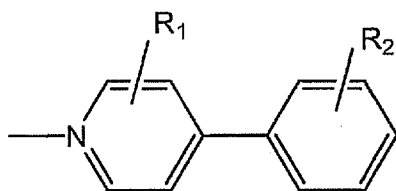
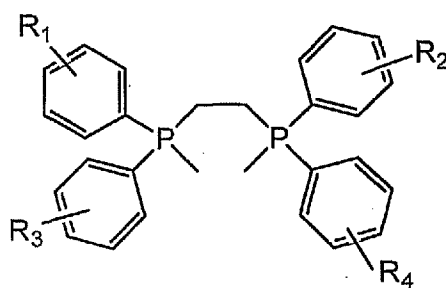
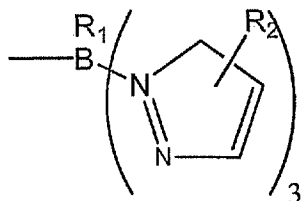


X = CH, N and
E = O, S, Se, Te

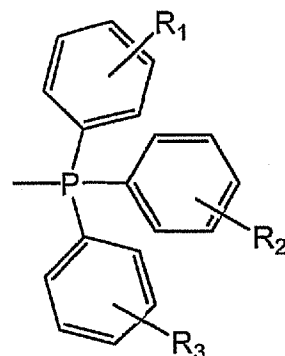
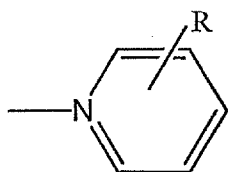


—R





and



wherein R, R₁, R₂, R₃, R₄, R₅, R₆, R₇ and R₈ are, independently, hydrogen, halogen, alkyl or aryl.

10. The organic light emitting device of claim 1, wherein the emissive layer further comprises:
 a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of

the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.

11. The organic light emitting device of claim 2, wherein the emissive layer further comprises:

a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.

12. The organic light emitting device of claim 3, wherein the emissive layer further comprises:

a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.

13. The organic light emitting device of claim 4, wherein the emissive layer further comprises:
a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.
14. The organic light emitting device of claim 5, wherein the emissive layer further comprises:
a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.

15. The organic light emitting device of claim 6, wherein the emissive layer further comprises:
- a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.
16. The organic light emitting device of claim 7, wherein the emissive layer further comprises:
- a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.
17. The organic light emitting device of claim 8, wherein the emissive layer further comprises:

a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.

18. The organic light emitting device of claim 9, wherein the emissive layer further comprises:

a host material having a lowest triplet excited state having a first decay rate of less than about 1 per second; wherein the organometallic compound is present as a guest material dispersed in the host material, the organometallic compound having a lowest triplet excited state having a radiative decay rate of greater than about 1×10^5 per second and wherein the energy level of the lowest triplet excited state of the host material is lower than the energy level of the lowest triplet excited state of the organometallic compound.

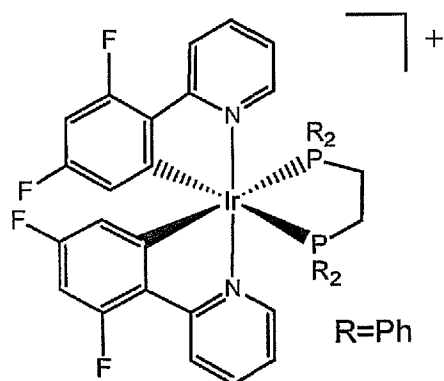
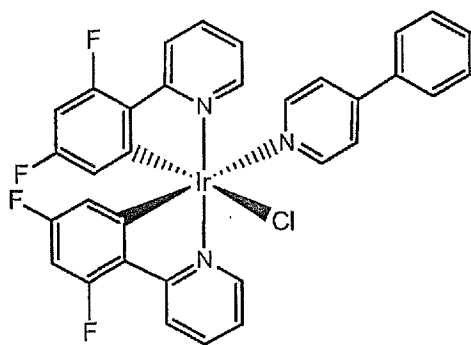
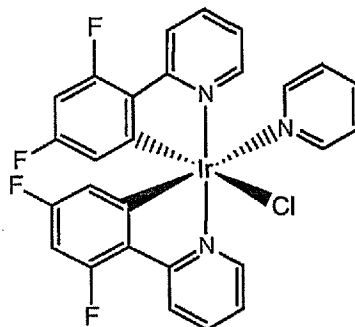
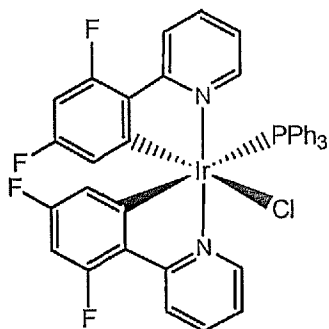
19. The organic light emitting device of claim 10, wherein the energy difference between the lowest triplet excited state of the organometallic compound and a

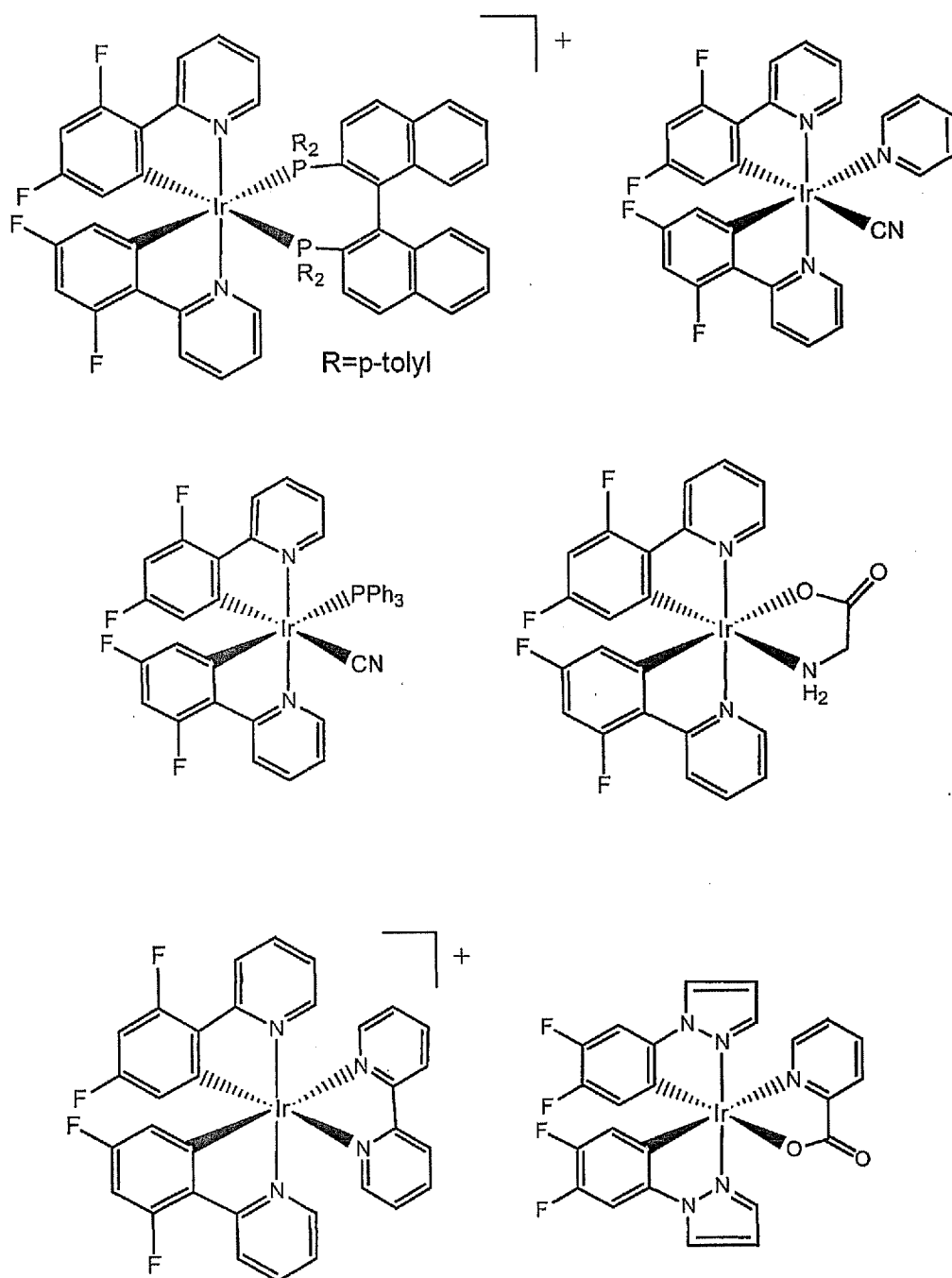
corresponding relaxed stated of the organometallic compound has a corresponding wavelength of about 420 nm to 480 nm for blue light emission.

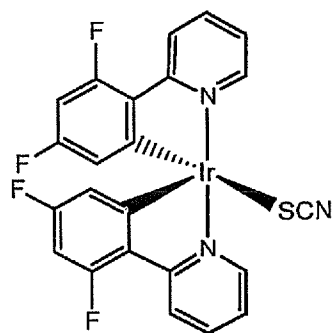
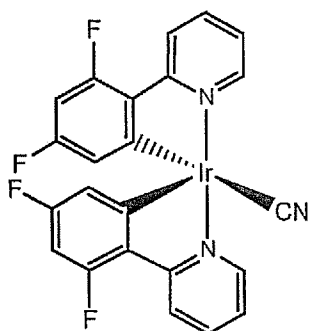
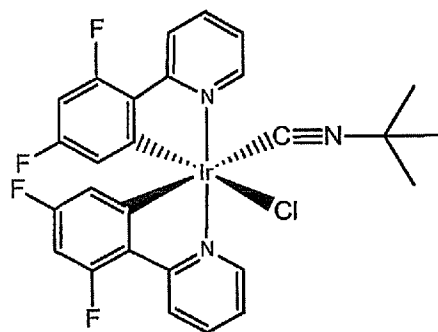
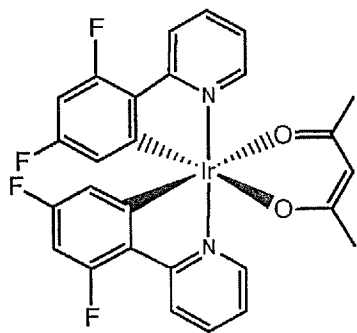
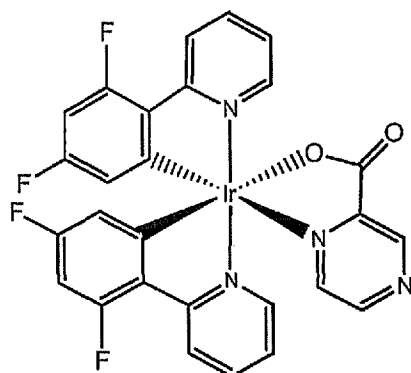
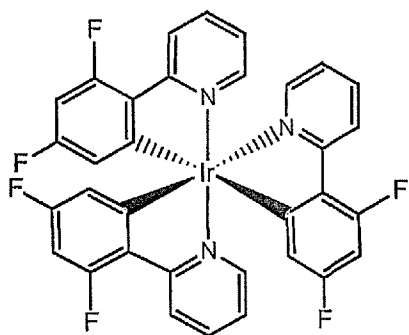
20. The organic light emitting device of claim 10, wherein the energy difference between the lowest triplet excited state of the organometallic compound and a corresponding relaxed stated of the organometallic compound has a corresponding wavelength of about 480 nm to 510 nm for aqua-blue light emission.
21. The organic light emitting device of claim 10, wherein the host material has a bandgap with an energy difference corresponding to about 470 nm and the organometallic compound has a lowest triplet excited state at an energy level at about 450 nm.
22. The organic light emitting device of claim 10, wherein the host material is an electron transport layer.
23. The organic light emitting device of claim 10, wherein the host material conducts electrons primarily through hole transmission.
24. The organic light emitting device of claim 10, wherein the ratio of the host material and organometallic compound decay rates is at least about 1:1000 to about 5:1000.
25. The organic light emitting device of claim 10, wherein the host material is TPD.

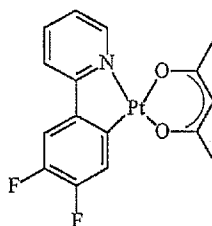
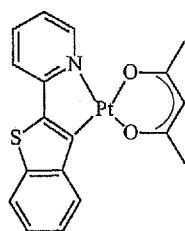
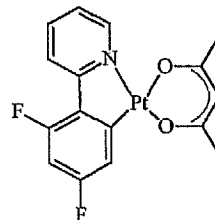
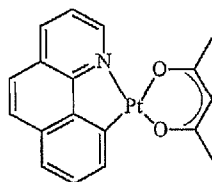
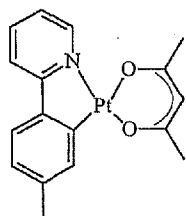
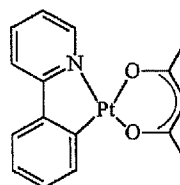
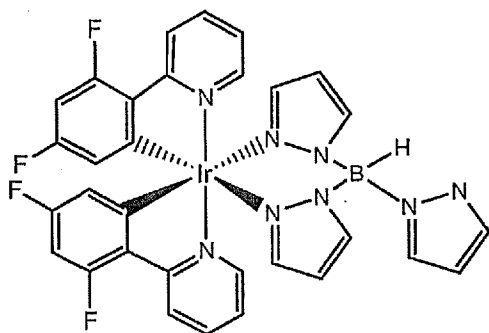
26. The organic light emitting device of claim 10, wherein a plurality of organometallic compounds are dispersed in the host material.
27. An organometallic compound comprising:
a heavy transition metal that produces an efficient phosphorescent emission at room temperature from a mixture of metal-to-ligand charge transfer and $\pi - \pi^*$ ligand states;
at least one mono-anionic, bidentate, carbon-coordination ligand bound to the heavy transition metal, wherein the at least one mono-anionic, bidentate, carbon-coordination ligand is substituted with at least one of an electron donating substituent and an electron withdrawing substituent, wherein the at least one of an electron donating substituent and an electron withdrawing substituent shifts the emission, relative to an un-substituted mono-anionic, bidentate, carbon-coordination ligand, to either the blue, green or red region of the visible spectrum;
and
at least one non-mono-anionic, bidentate, carbon-coordination ligand bound to the heavy transition metal, wherein the at least one non-mono-anionic, bidentate, carbon-coordination ligand causes the emission to have a well defined vibronic structure.
28. The organometallic compound of claim 27, wherein the heavy transition metal is selected from the group consisting of Os, Ir, Pt and Au.

29. An organometallic compound comprising:
- a heavy transition metal;
 - at least one mono-anionic, bidentate, carbon-coordination ligand bound to the heavy transition metal; and
 - at least one non-mono-anionic, bidentate, carbon-coordination ligand bound to the heavy transition metal, wherein the organometallic compound has a chemical structure represented by a formula selected from the group consisting of:

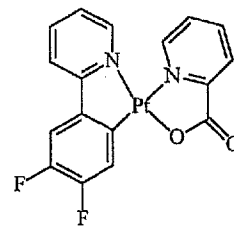




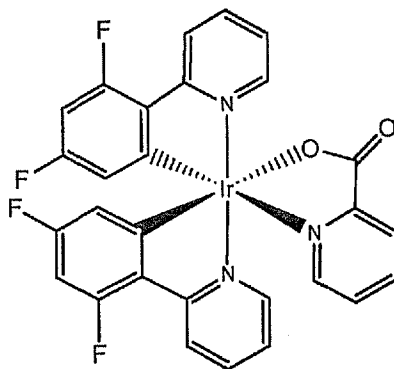




and



30. An organometallic compound comprising:
- a heavy transition metal;
 - at least one mono-anionic, bidentate, carbon-coordination ligand bound to the heavy transition metal; and
 - at least one non-mono-anionic, bidentate, carbon-coordination ligand bound to the heavy transition metal, wherein the organometallic compound has a chemical structure represented by the following formula:



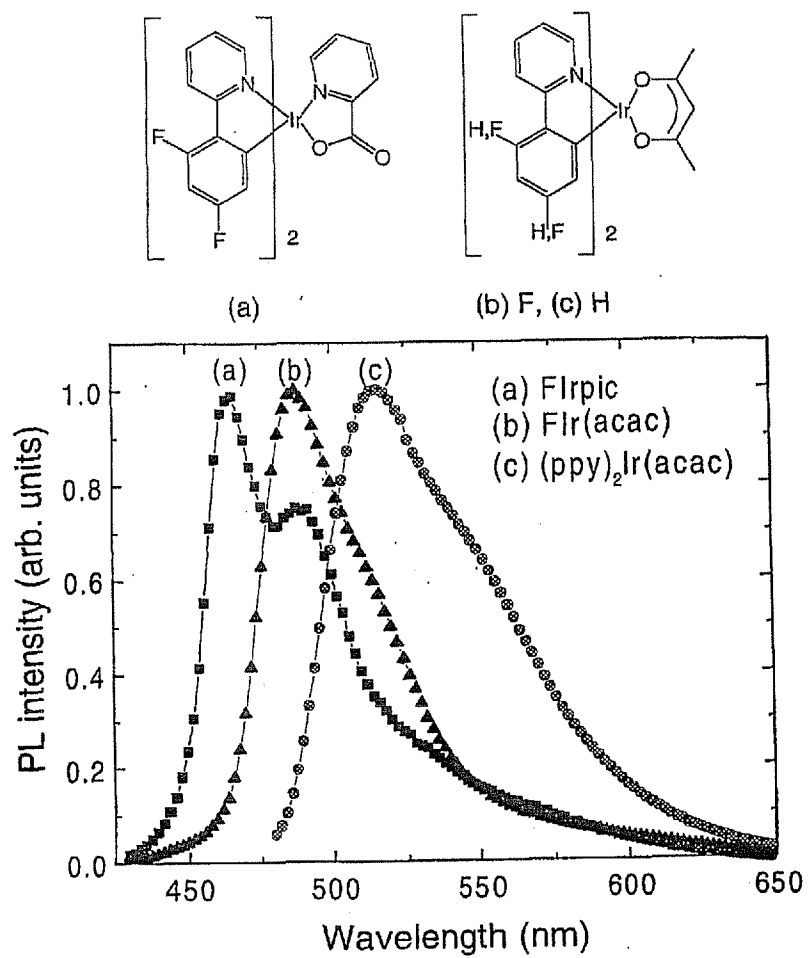


Figure 1a:

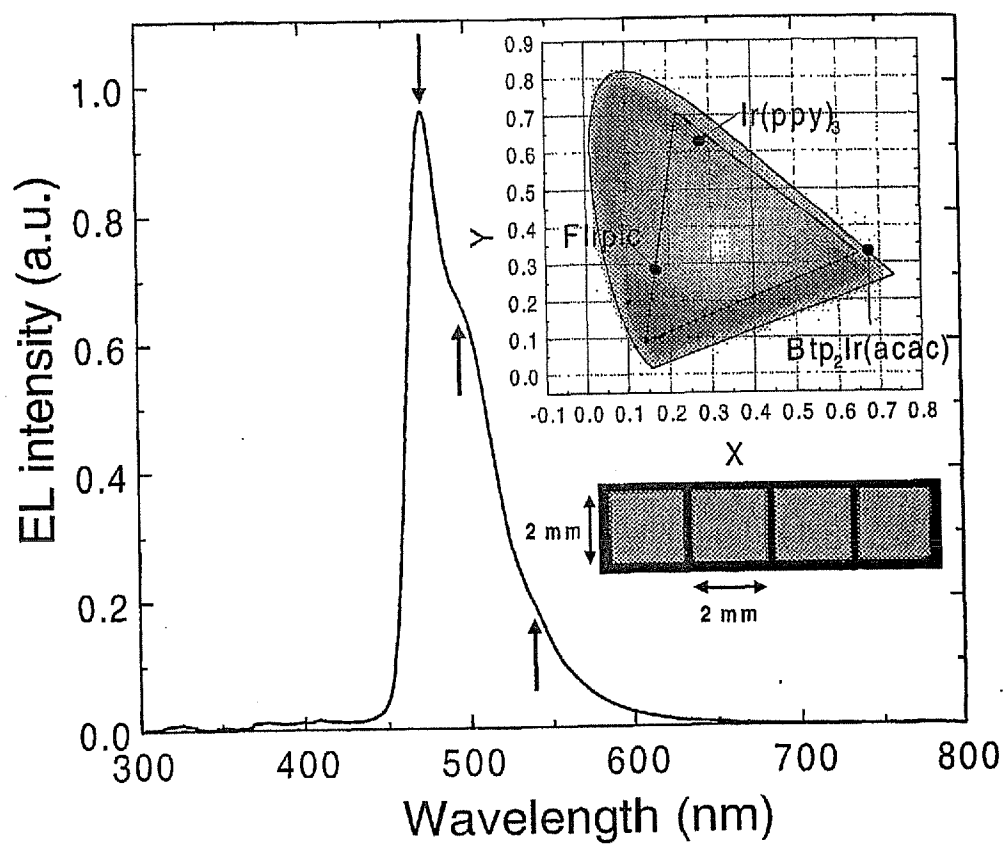


Figure 1b:

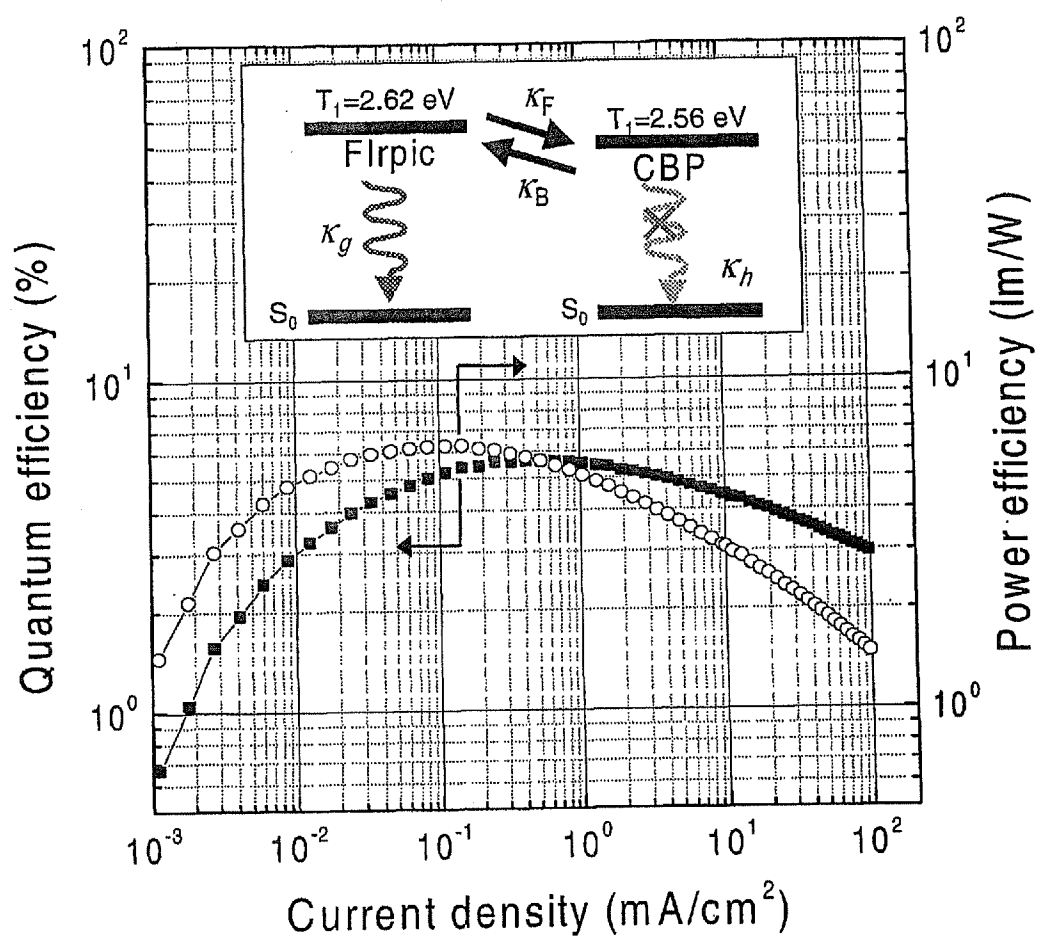


Figure 2:

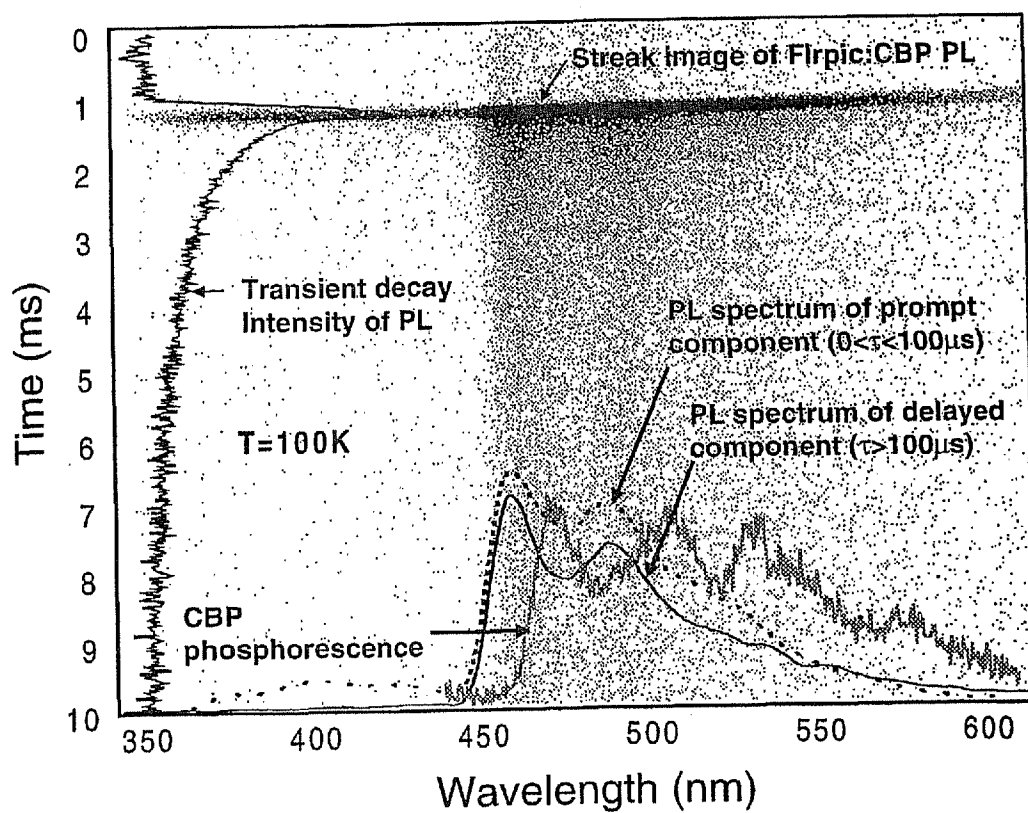


Figure 3:

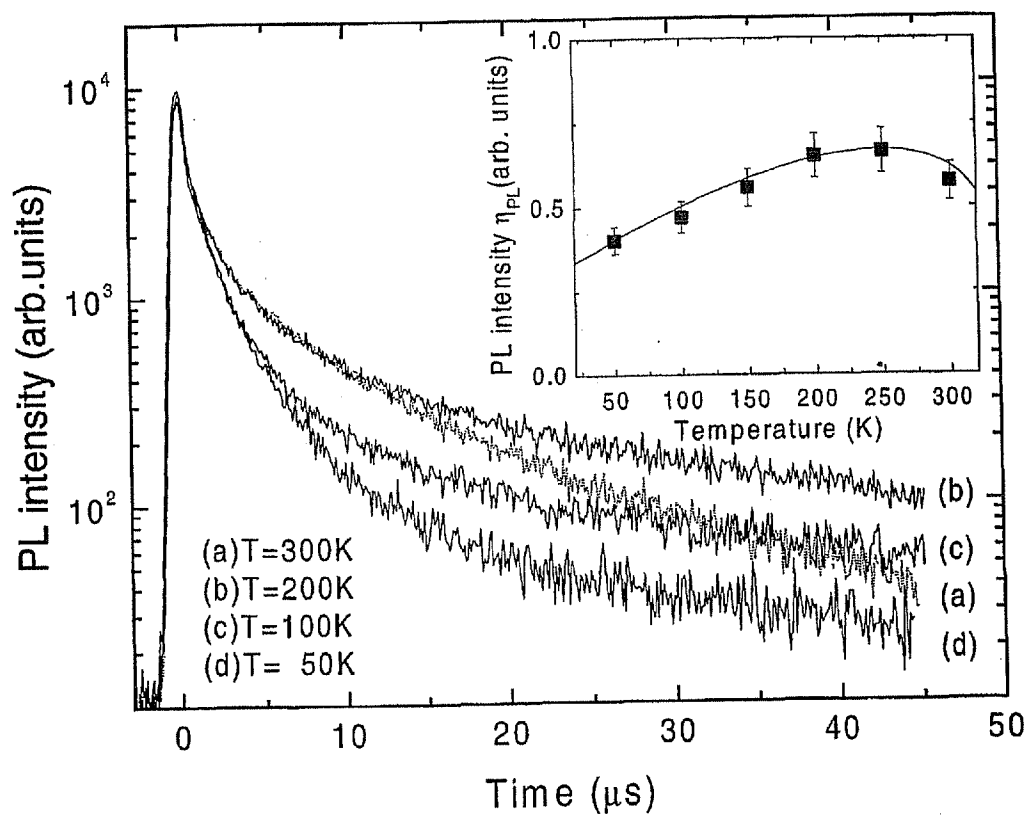
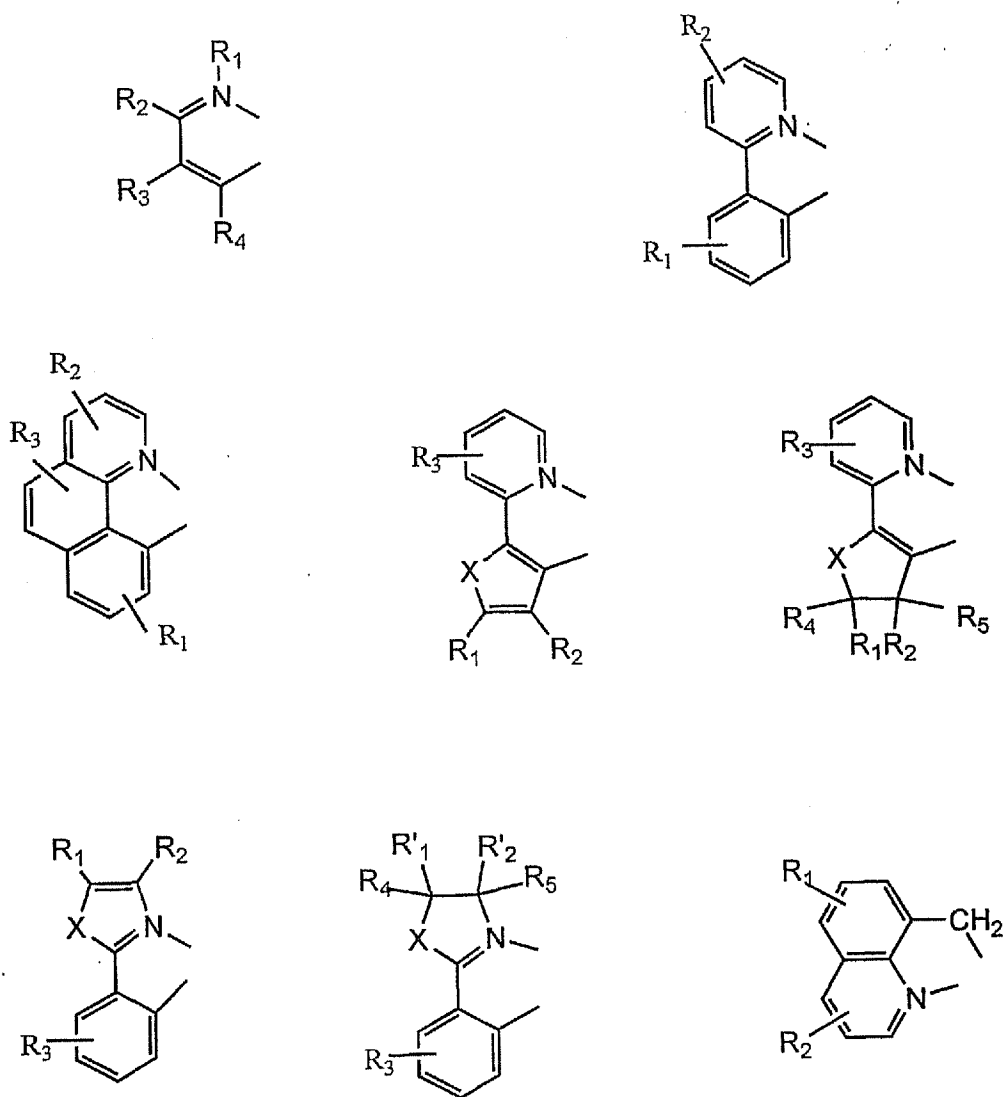


Figure 4:

Figure 5a

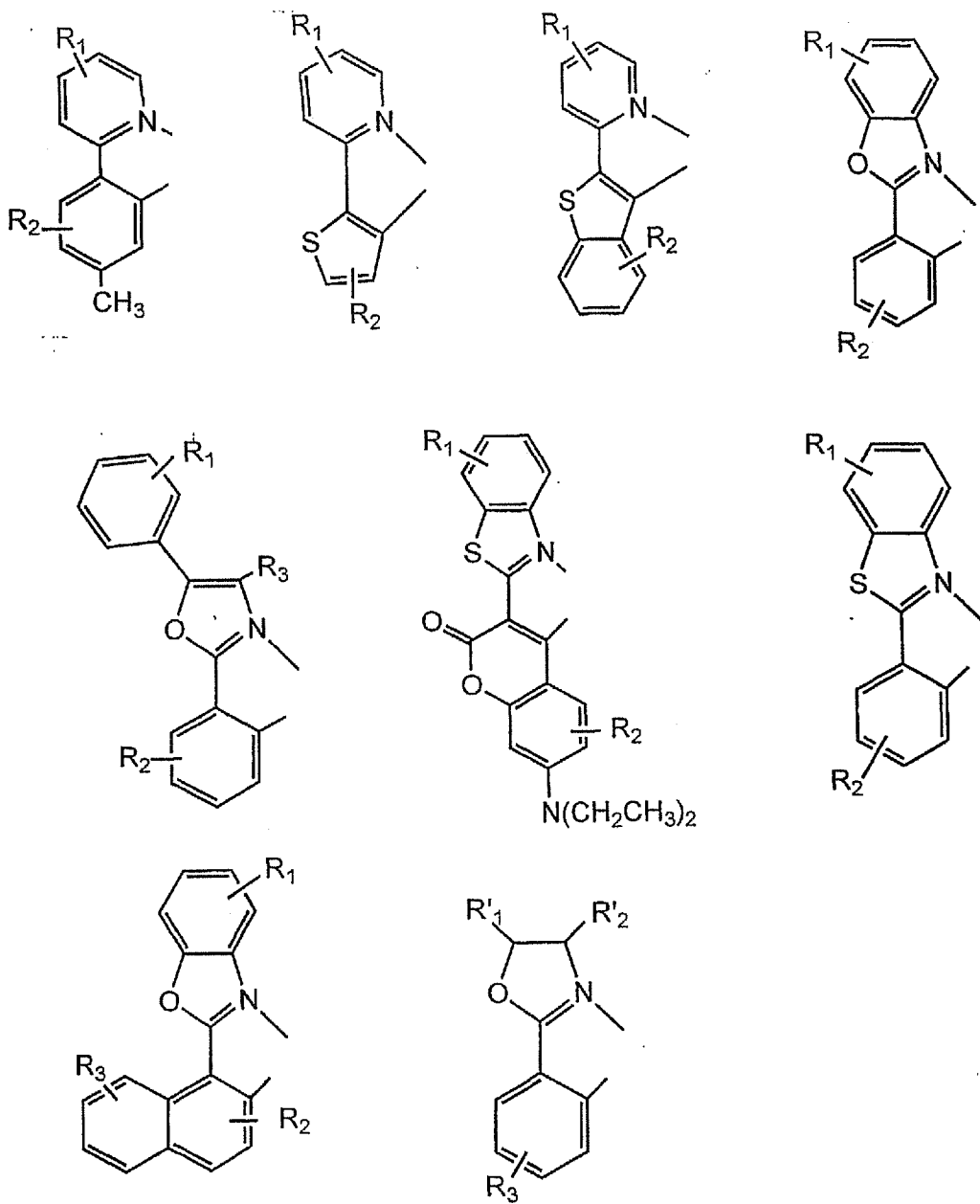
Generic Mono-Anionic, Bidentate, Carbon-Coordination Ligands-I



X = S, O, NR; and R₁, R₂, R₃, R₄ and R₅ are, independently, hydrogen, halogen, alkyl, aryl or arylene; and R'₁ and R'₂ may, in combination, be aryl.

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Figure 5b

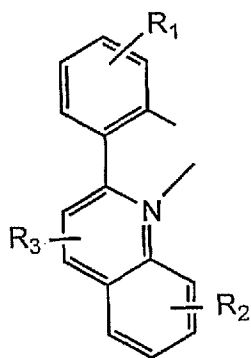
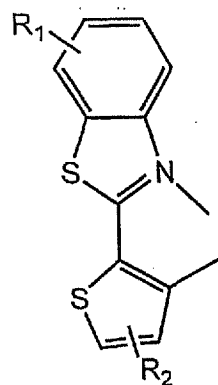
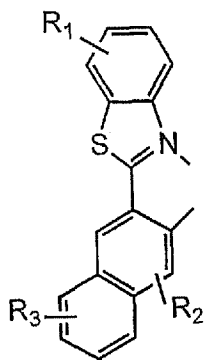
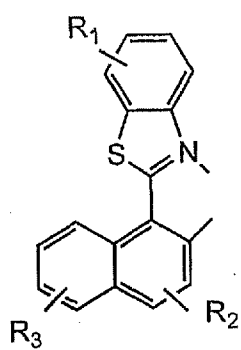
Generic Mono-Anionic, Bidentate, Carbon-Coordination Ligands-II



$X = S, O, NR$; and R_1, R_2, R_3, R_4 and R_5 are, independently, hydrogen, halogen, alkyl, aryl or arylene; and R'_1 and R'_2 may, in combination, be aryl.

Figure 5c

Generic Mono-Anionic, Bidentate, Carbon-Coordination Ligands-III



X = S, O, NR; and R₁, R₂, R₃, R₄ and R₅ are, independently, hydrogen, halogen, alkyl, aryl or arylene.

figure 5d

Specific Mono-Anionic, Bidentate, Carbon-Coordination Ligands-I

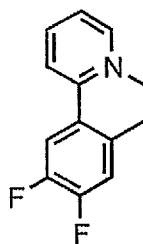
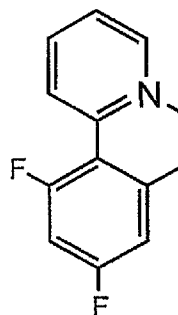
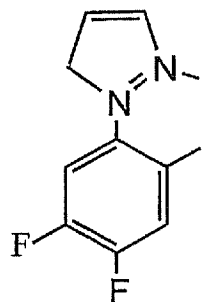
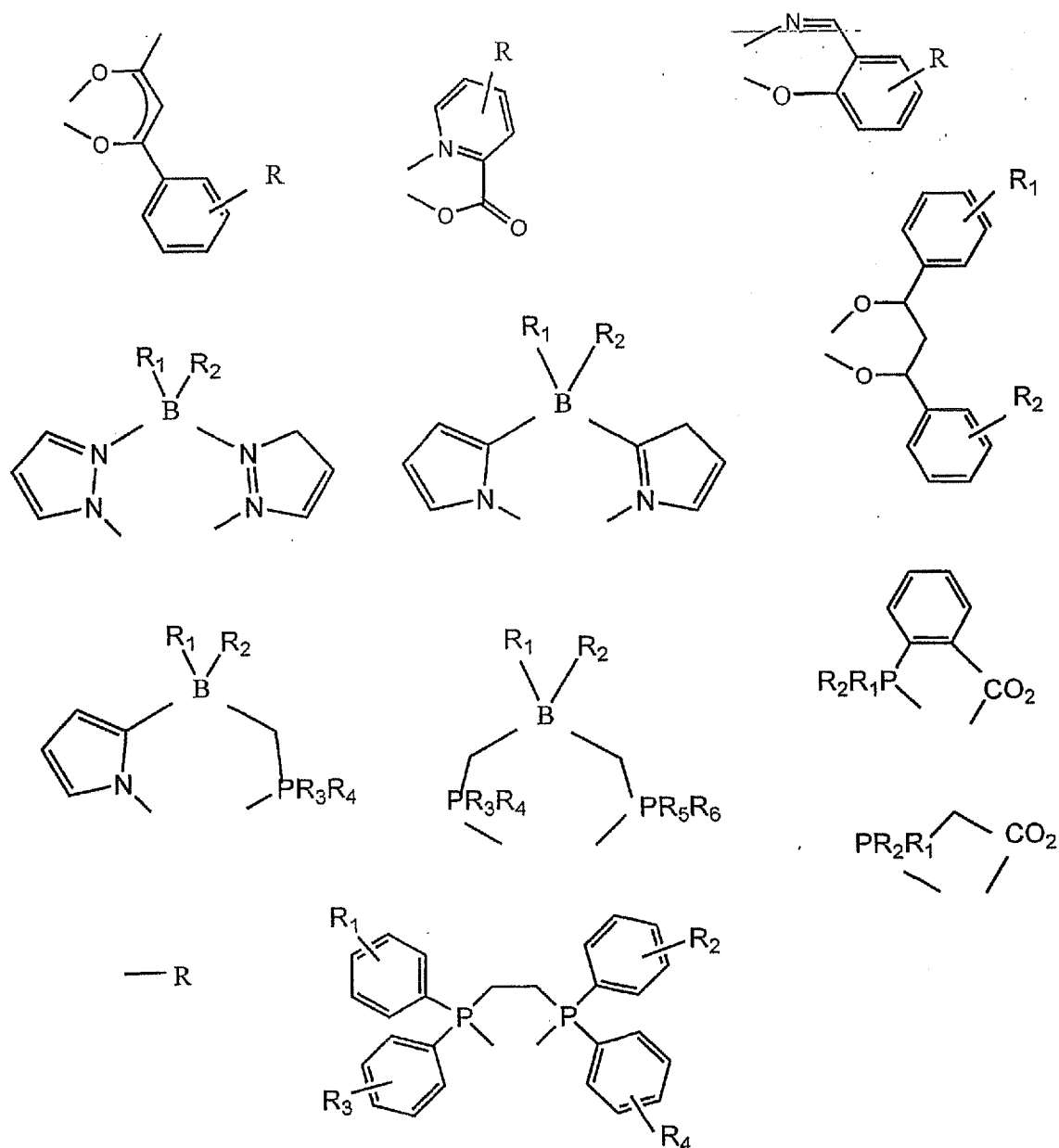


Figure 6a

Generic Non-Mono-Anionic, Bidentate, Carbon-Coordination Ligands-I



R, R₁, R₂, R₃, R₄, R₅, and R₆ are, independently, hydrogen, halogen, alkyl or aryl.

Figure 6c

Specific Non-Mono-Anionic, Bidentate, Carbon-Coordination Ligands

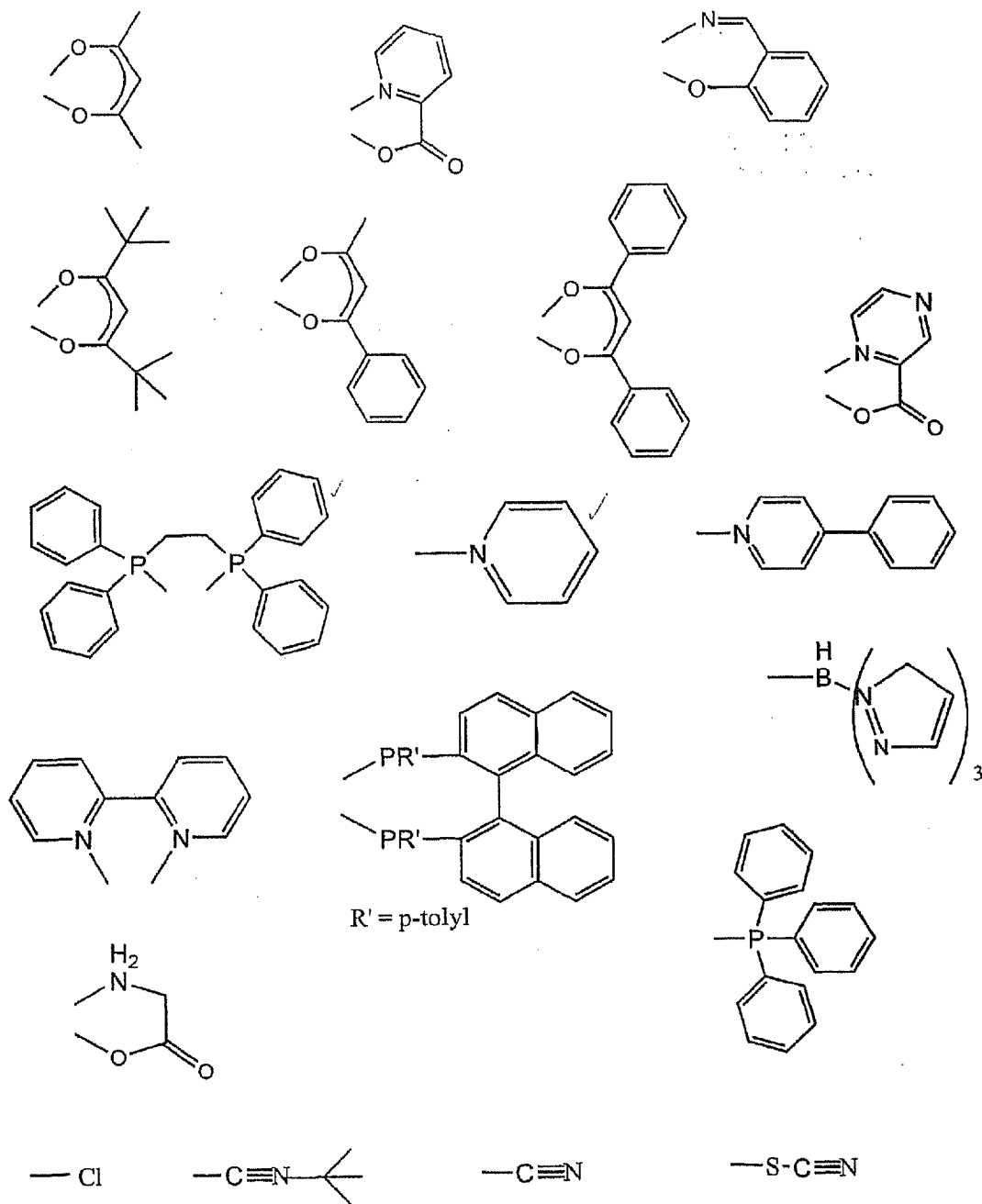


Figure 7a

$[(4,6\text{-F}_2\text{ppy})_2\text{IrCl}]_2 + \text{CNTBu}$ in CH_2Cl_2

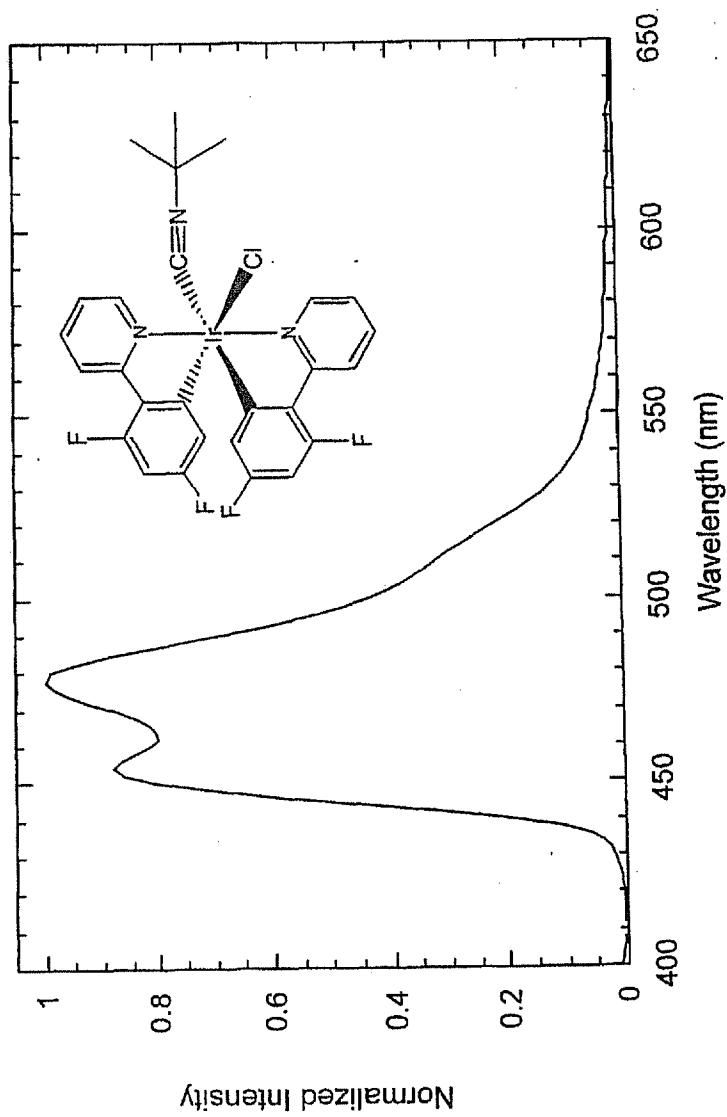


Figure 7b

$[\text{Ir}(\text{4,6-F}_2\text{ppy})_2\text{Cl}]_2 + \text{4-Phpyr}$ in CH_2Cl_2

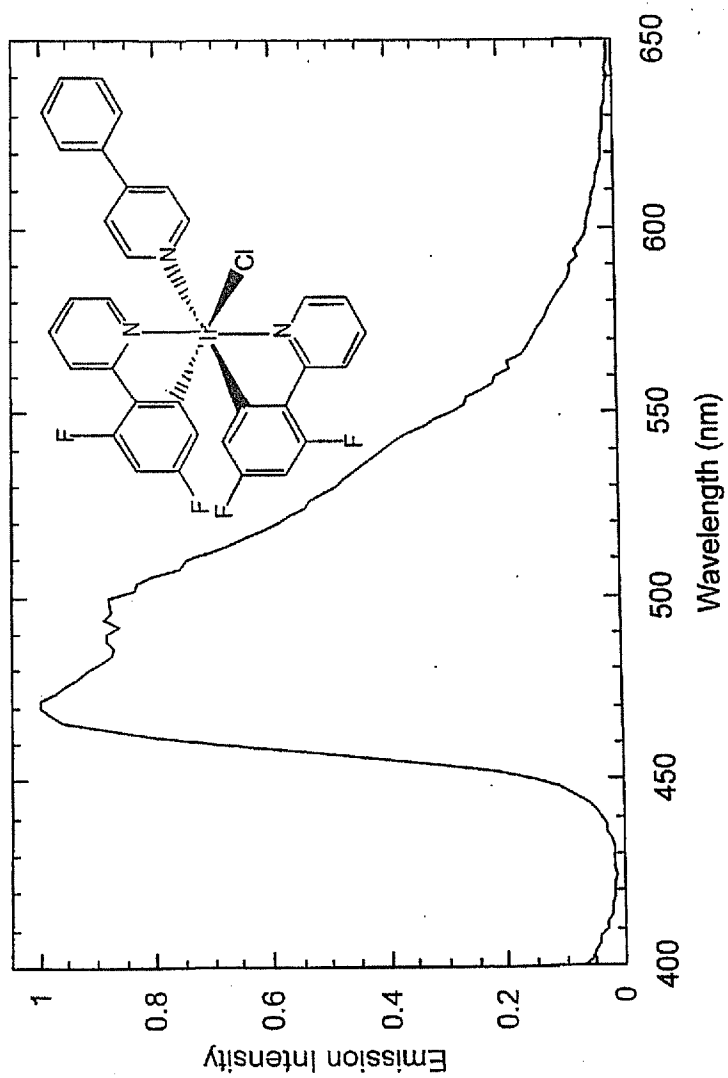


Figure 7c

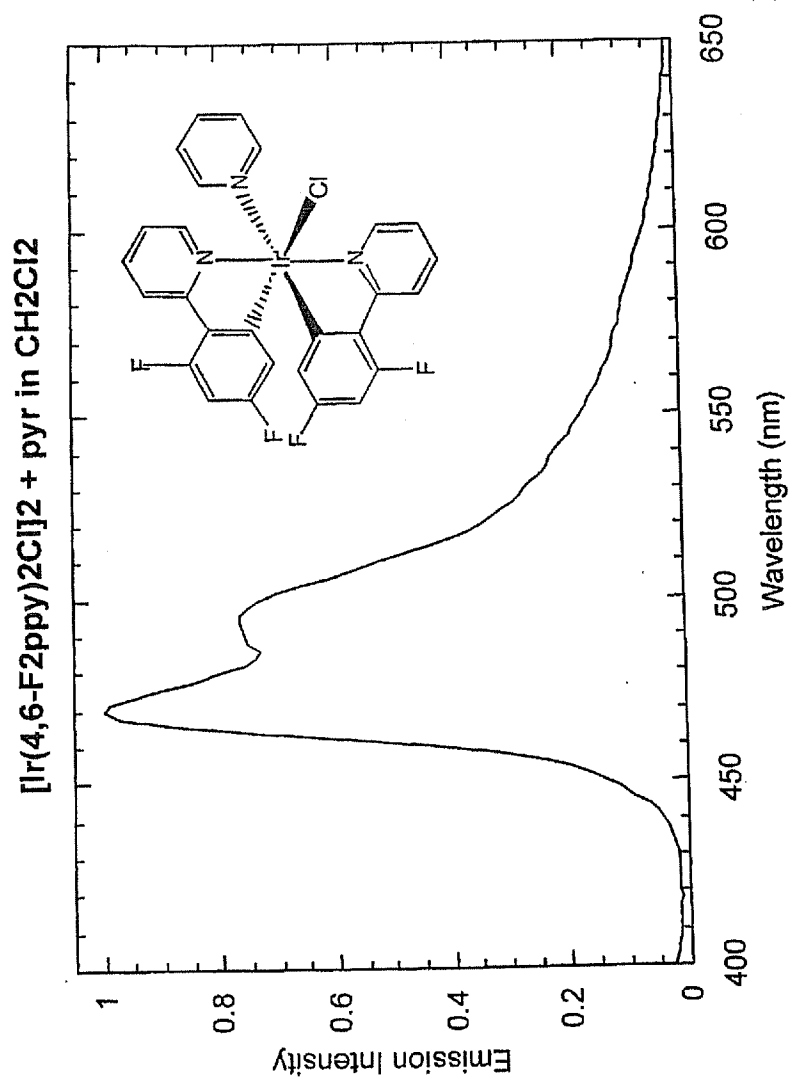


Figure 7d

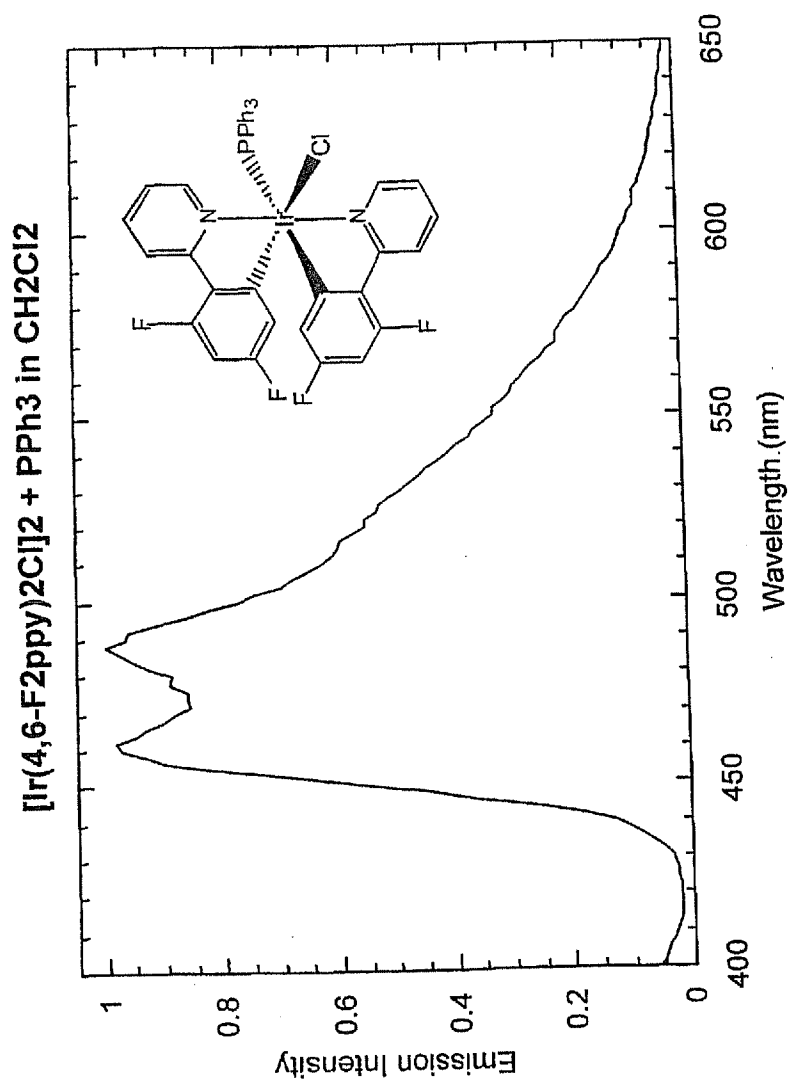


Figure 7e

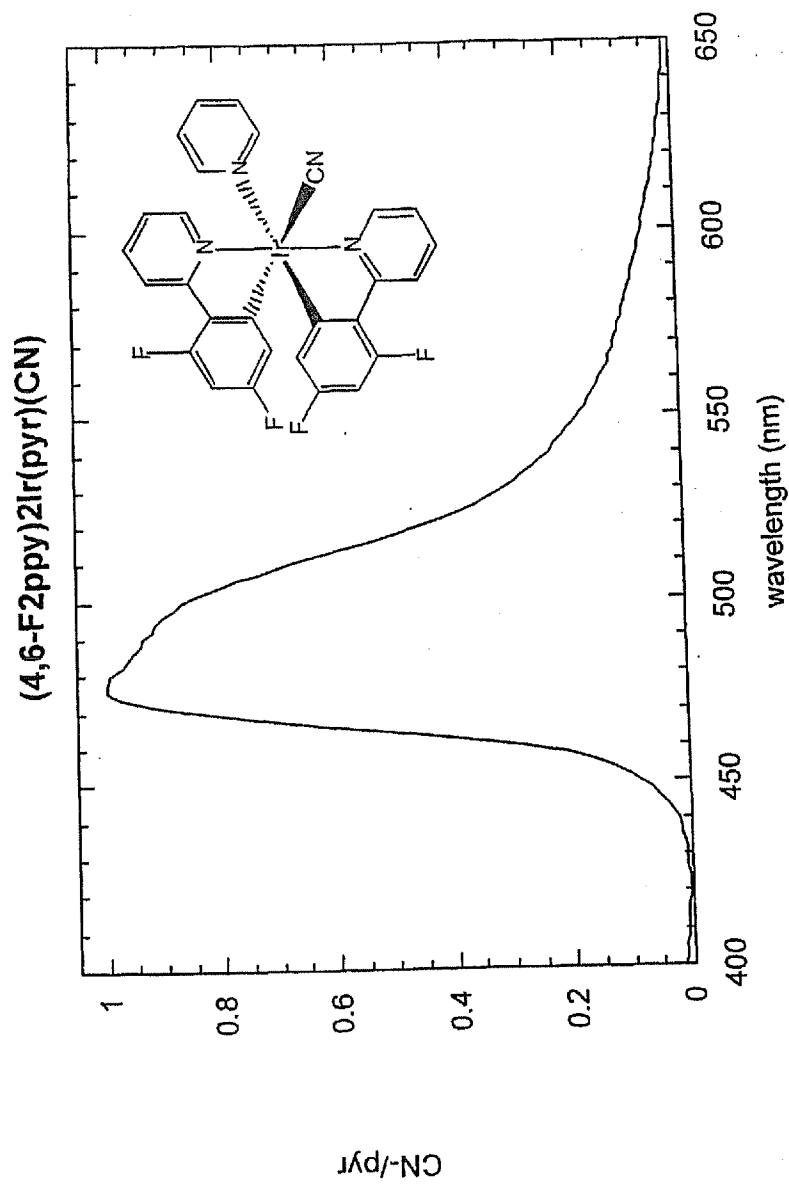


Figure 7f

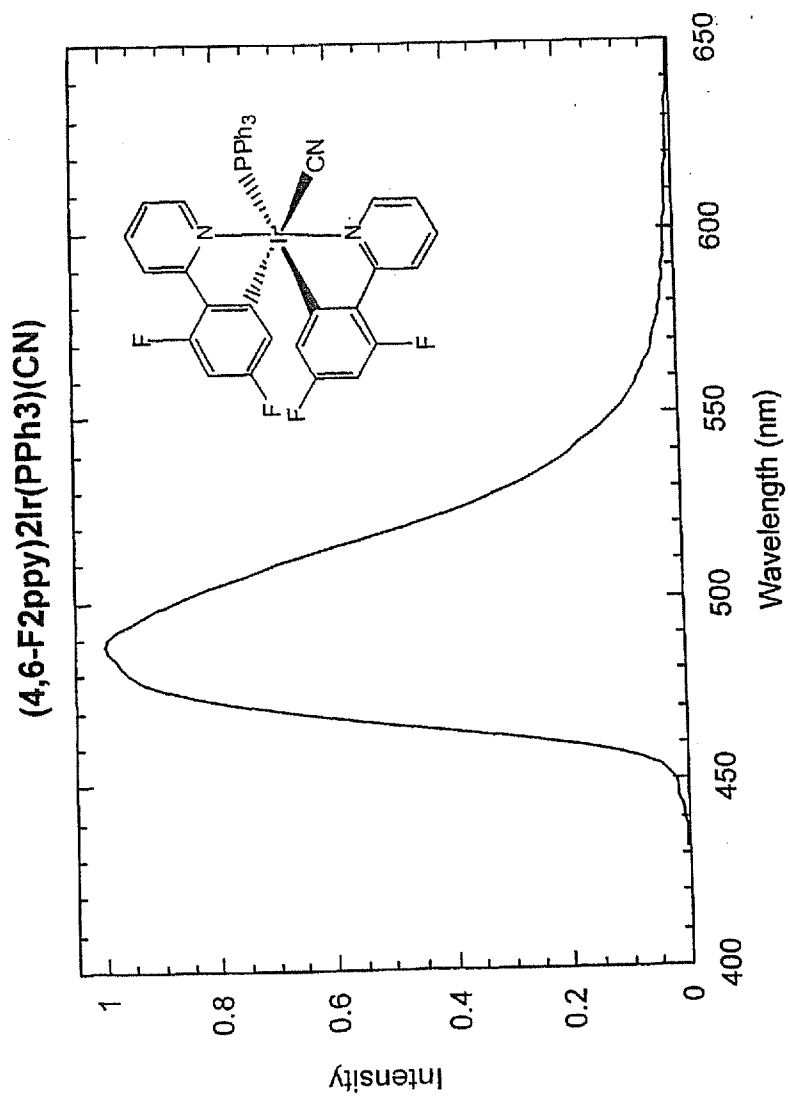


Figure 7g

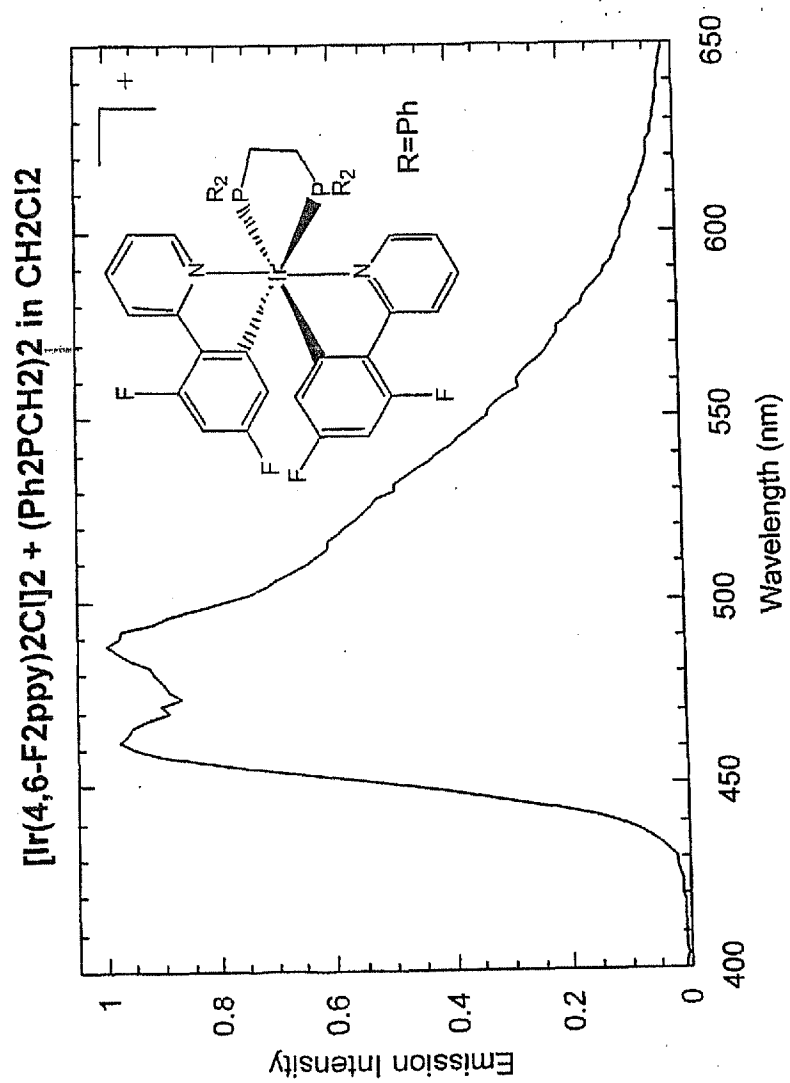


Figure 7h

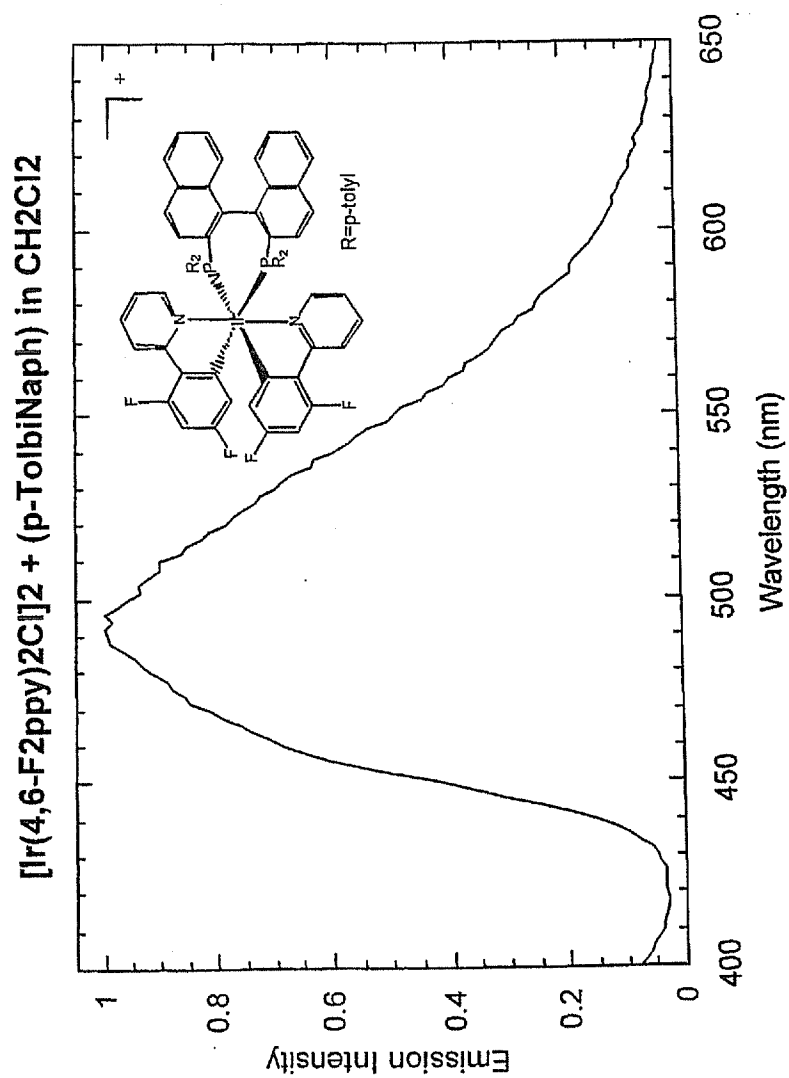


Figure 7i

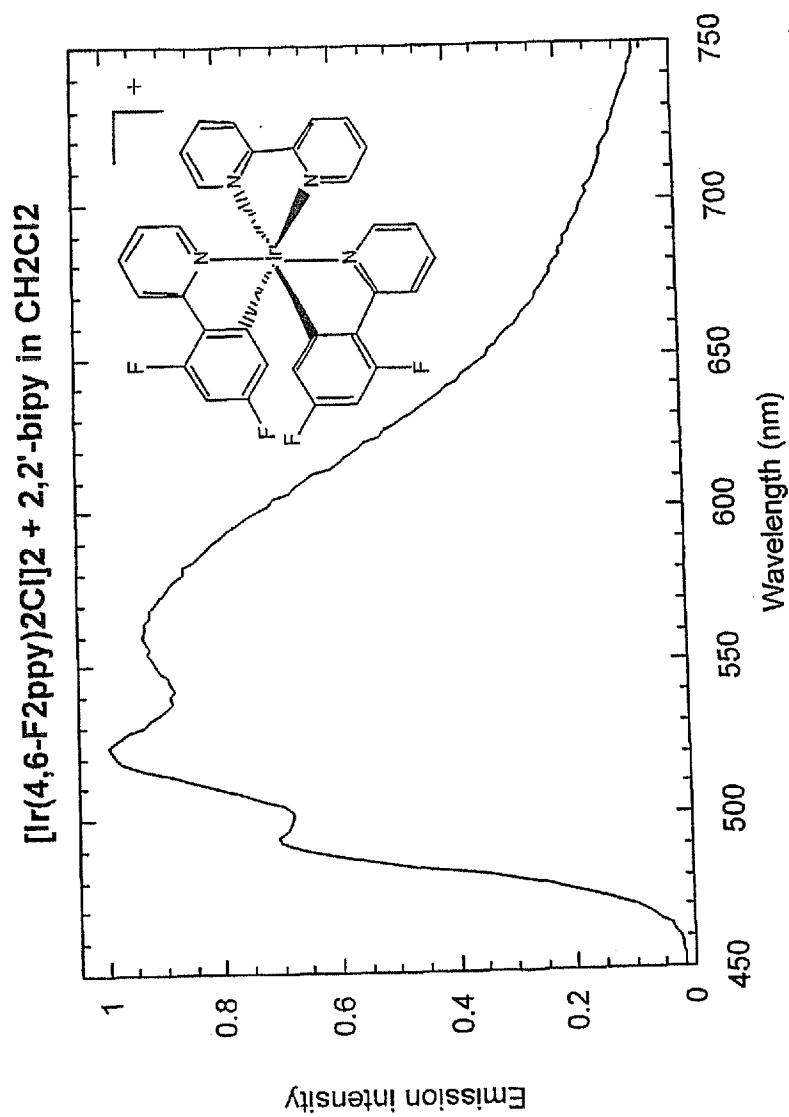


Figure 7j

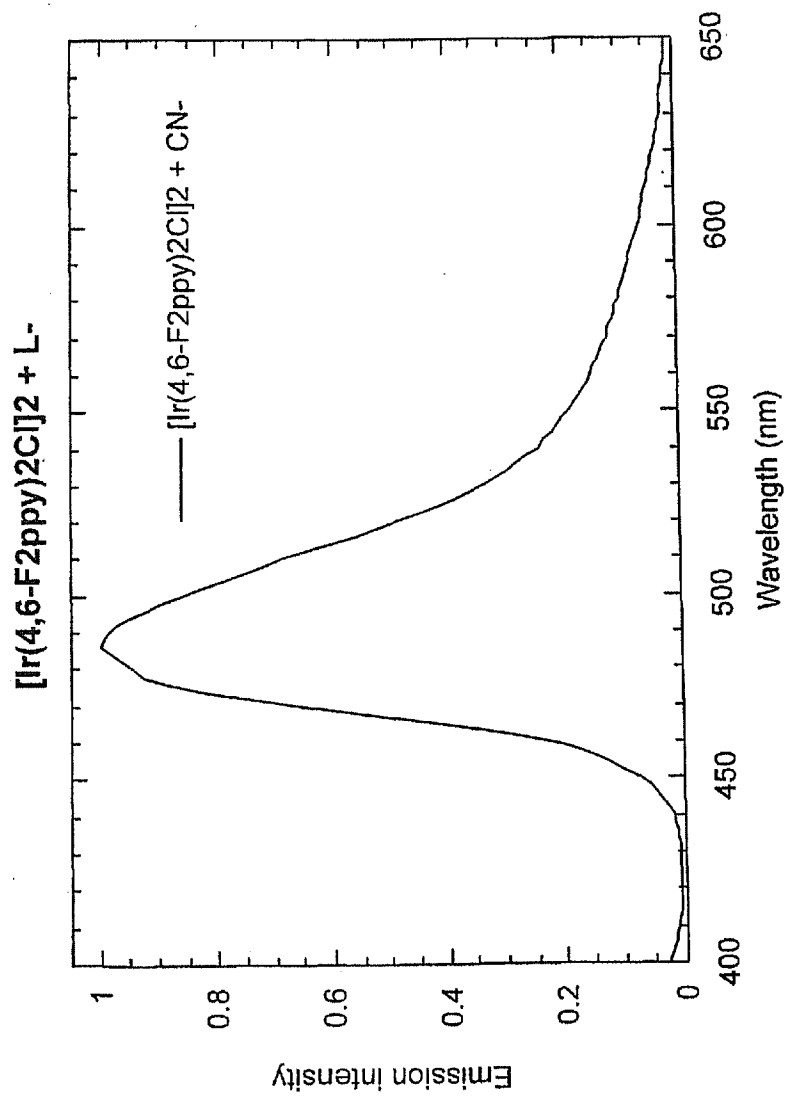


Figure 7k

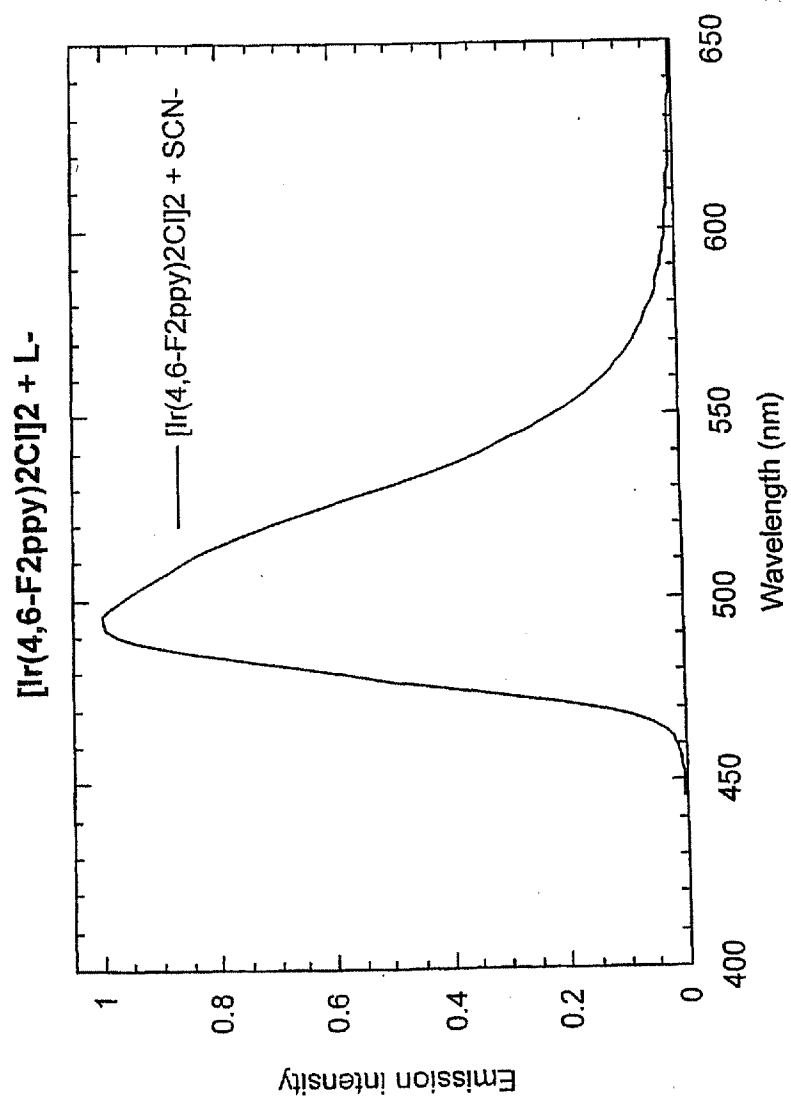


Figure 7d

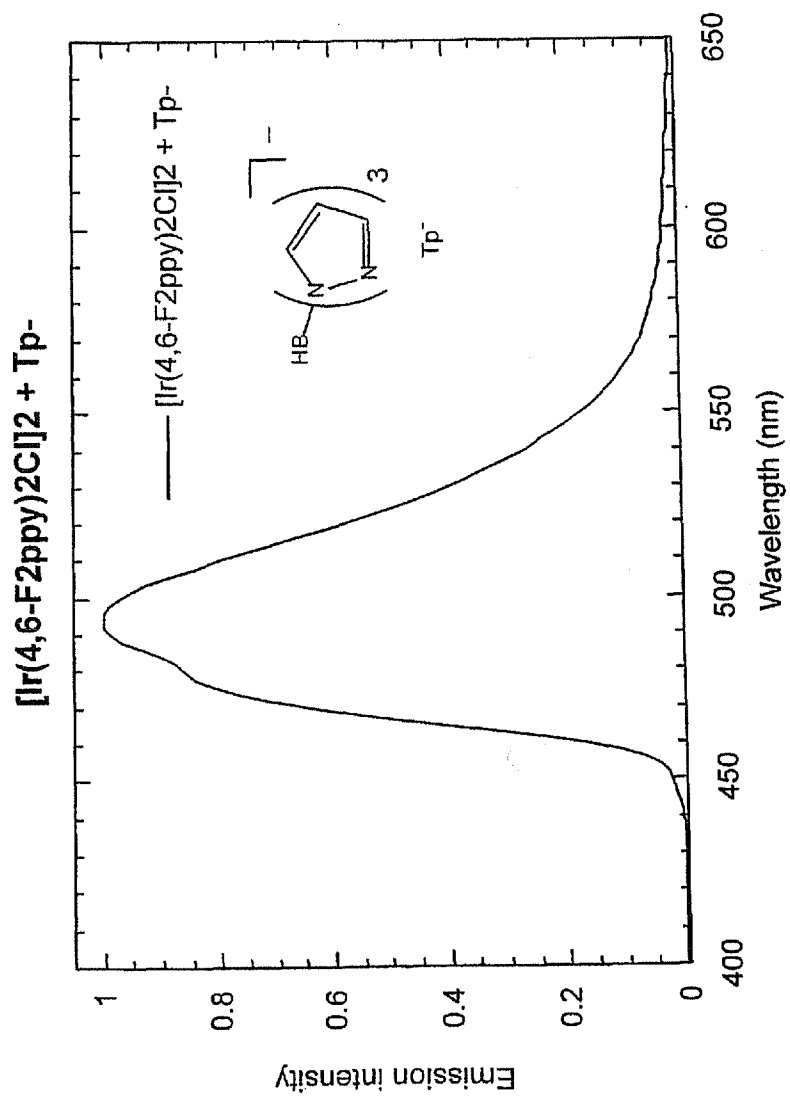


Figure 7m

Ir(4,6-F₂ppy)₂(acac) in CH₂Cl₂

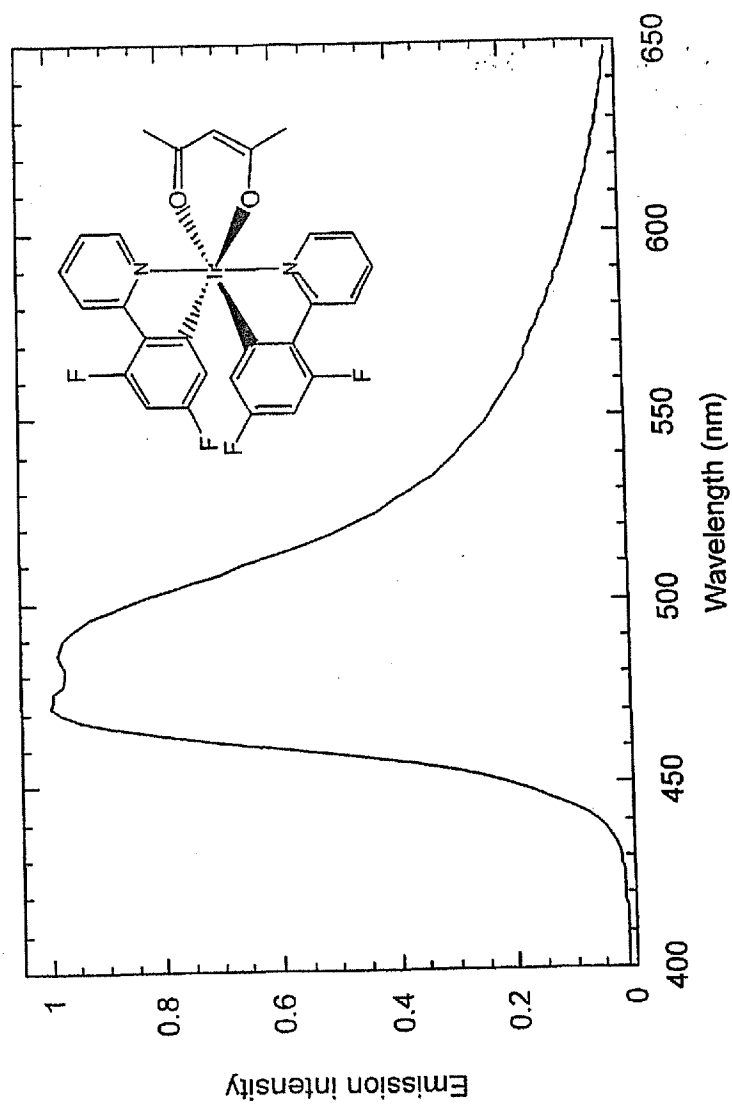


Figure 7n

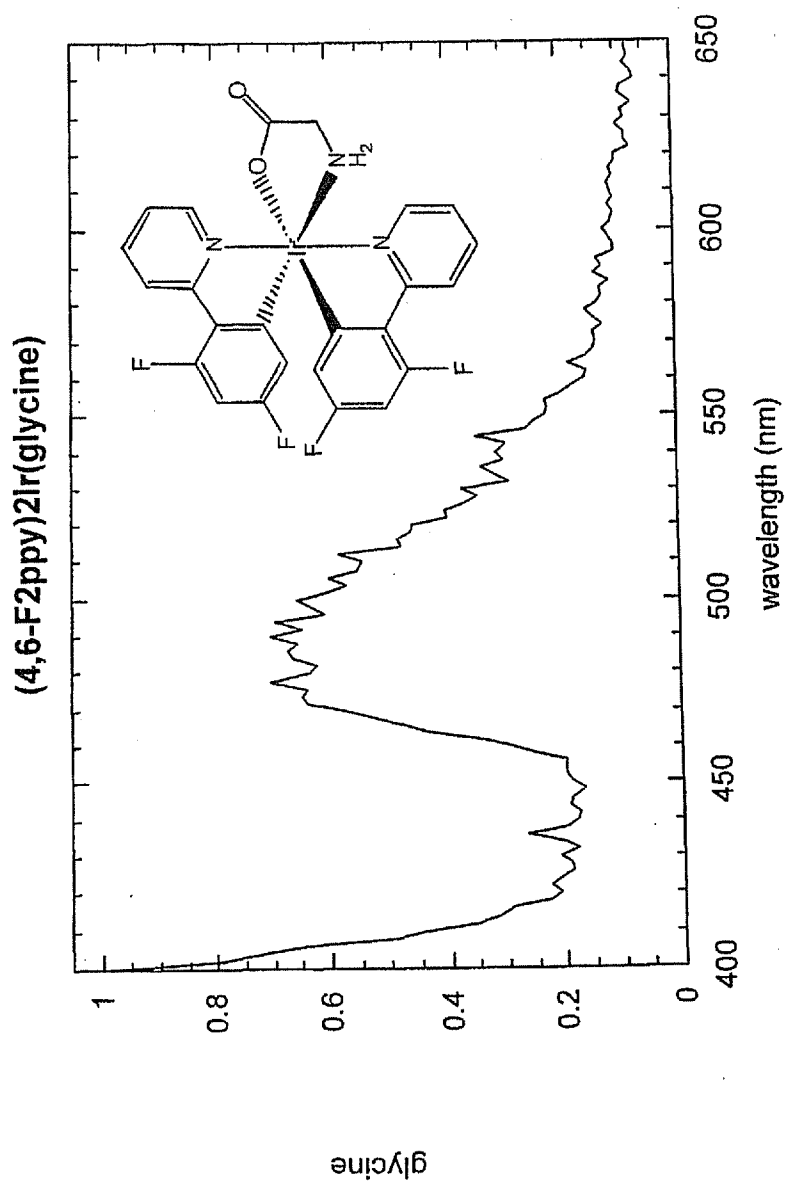


Figure 7o

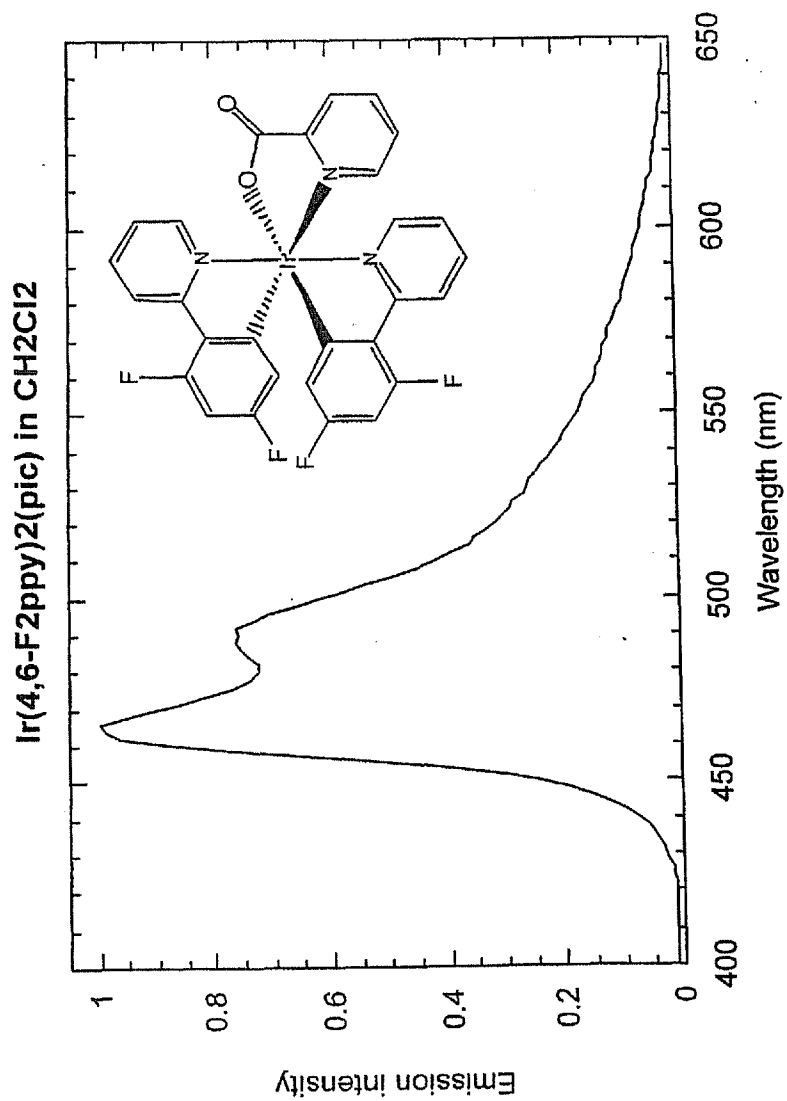


Figure 7p

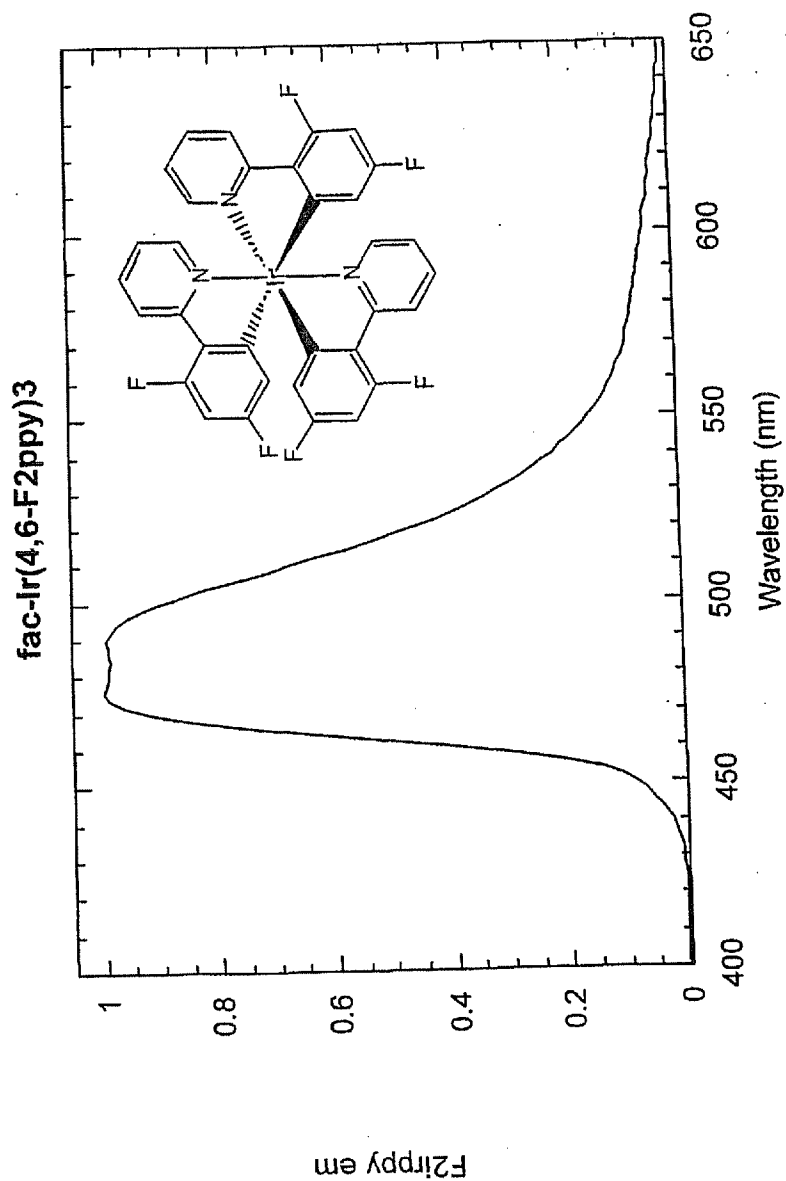


Figure 79

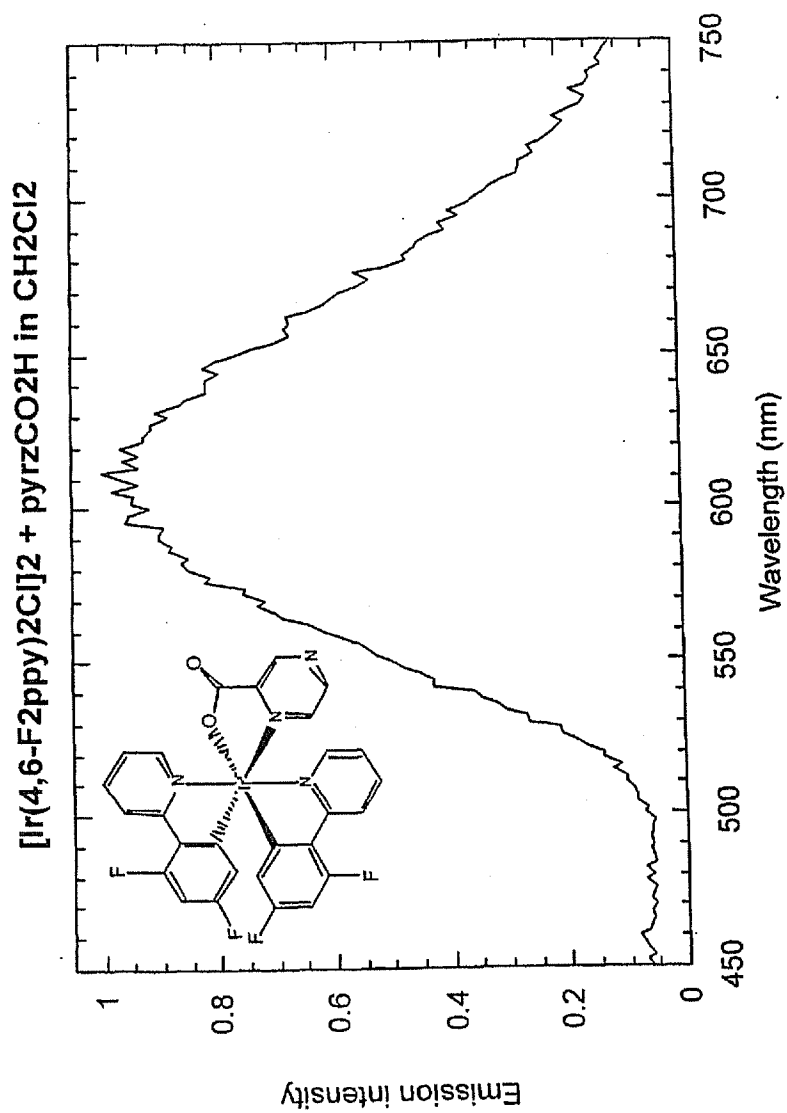


Figure 7r

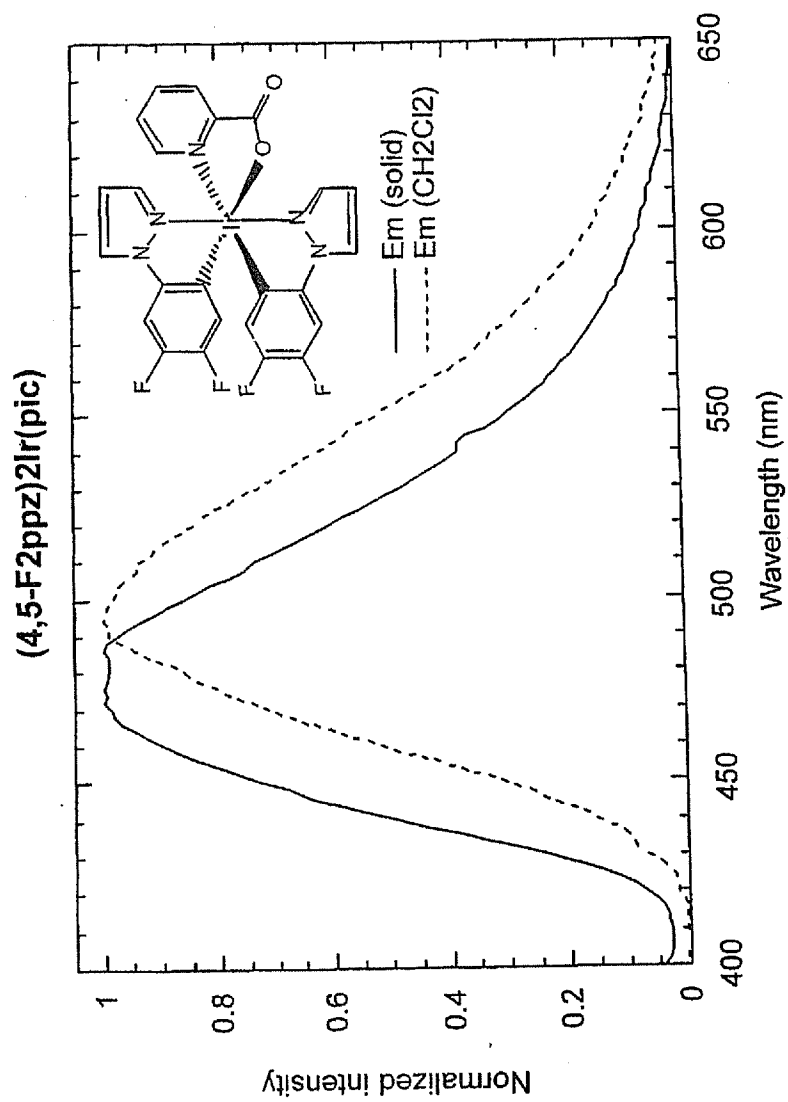
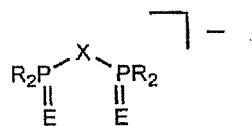
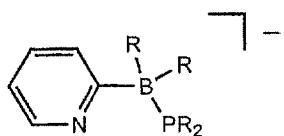
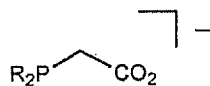
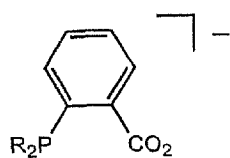
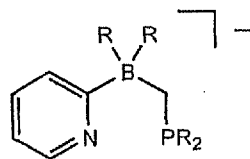
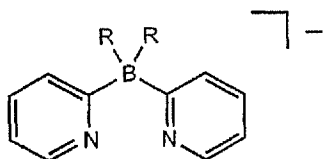
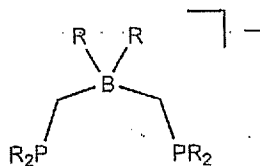
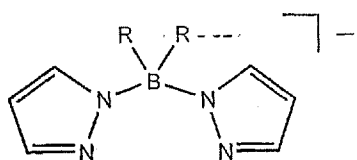


Figure 8a



X=CH, N
E=O, S, Se, Te

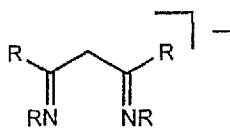


Figure 86

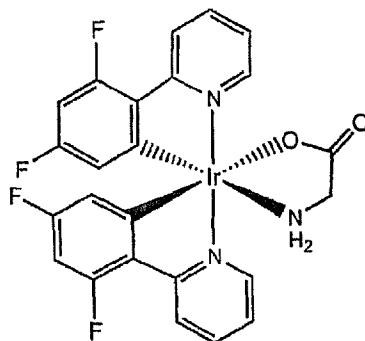
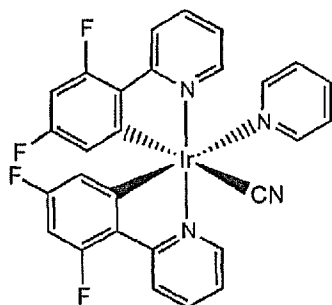
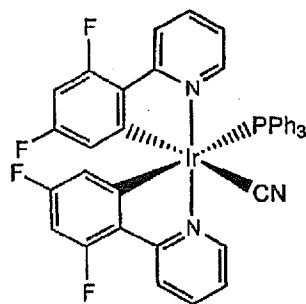
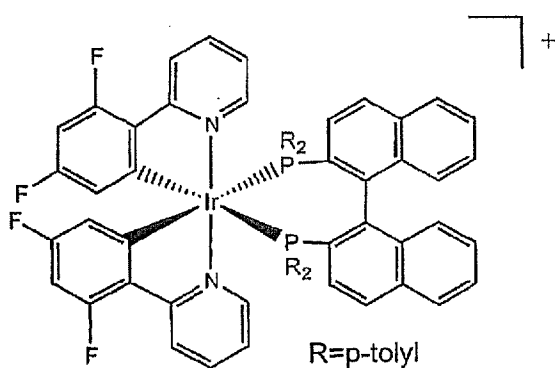
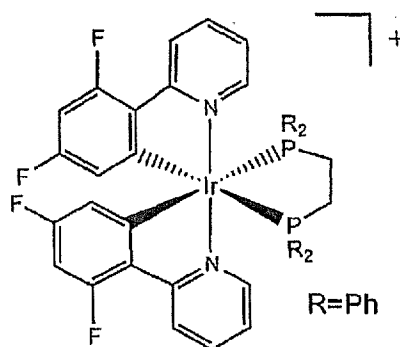
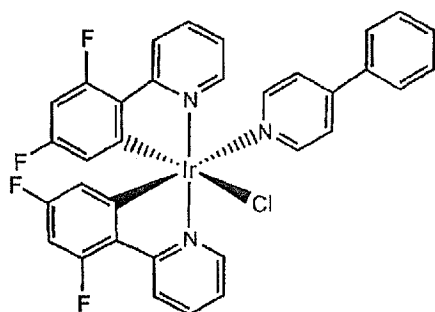
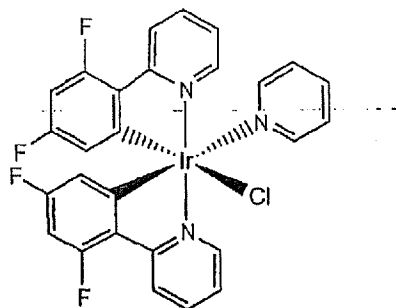
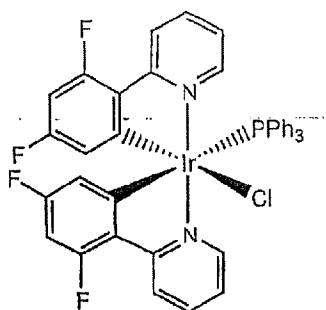


Figure 8c

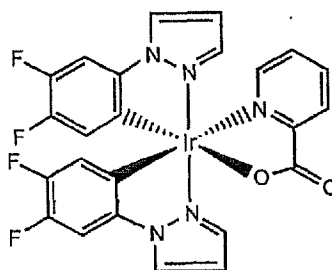
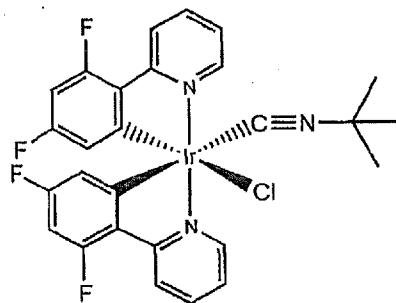
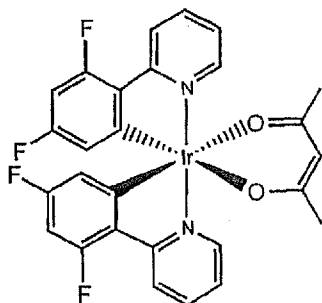
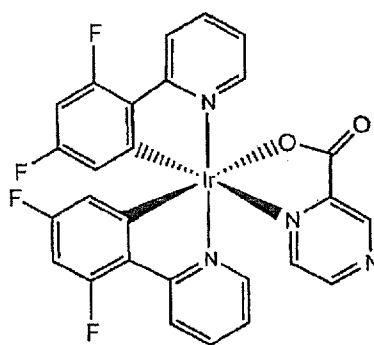
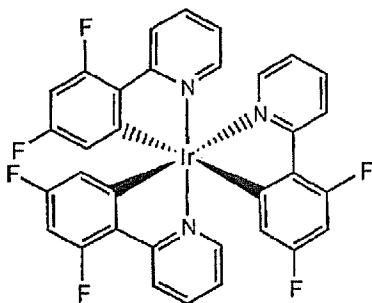
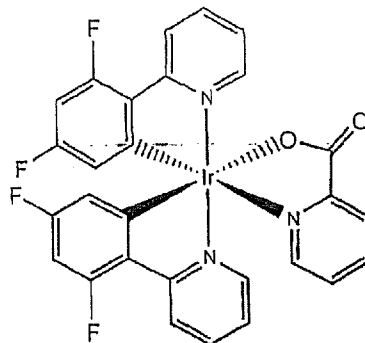
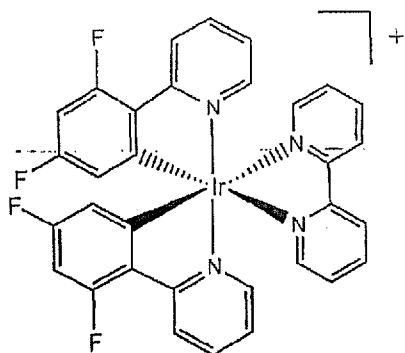
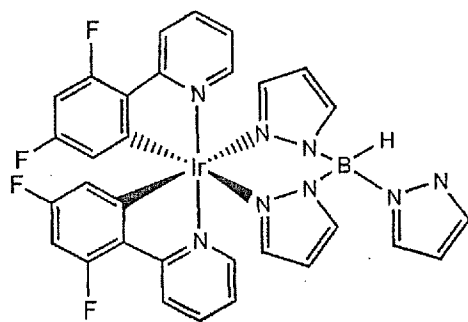
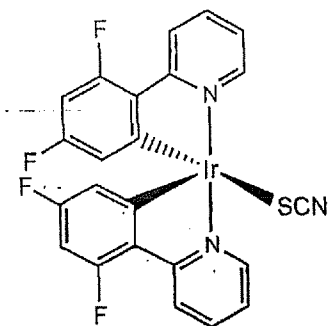
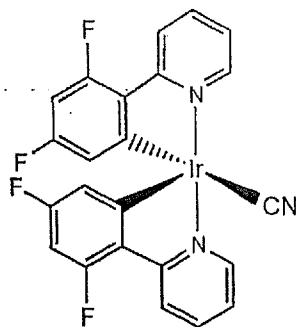
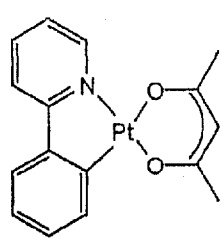


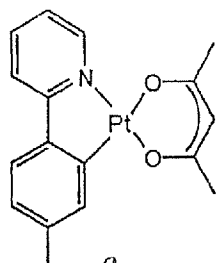
Figure 8d





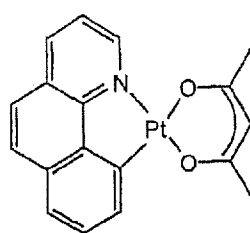
9(a)

(ppy)Pt(acac)



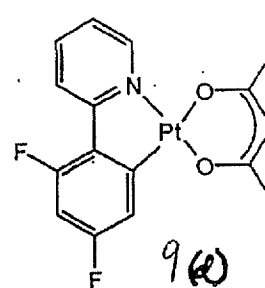
9(b)

(tpy)Pt(acac)

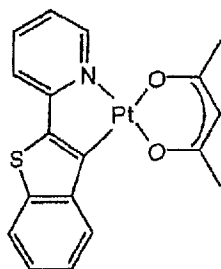


9(c)

(bzq)Pt(acac)

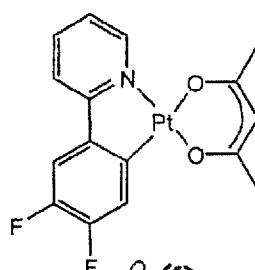


9(d)

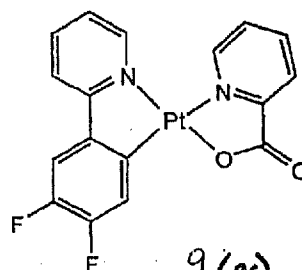
(4,6-F₂ppy)Pt(acac)

9(e)

(btp)Pt(acac)



9(f)

(4,5-F₂ppy)Pt(acac)

9(g)

(4,5-F₂ppy)Pt(pico)

Figures 9(a) - 9(g)

Figure 10: This Emission spectrum shows the spectra of both Pt(ppy)_2 and $\text{Pt(ppy)}_2\text{Br}_2$. The former gives green emission, partly from MLCT transitions, and the latter gives blue emission, predominantly from a triplet $\pi-\pi^*$ transition. The structure observed for the $\text{Pt(ppy)}_2\text{Br}_2$ spectrum is consistent with ligand centered emission. The luminescent lifetimes for the two complexes are 4 and 150 μsec .

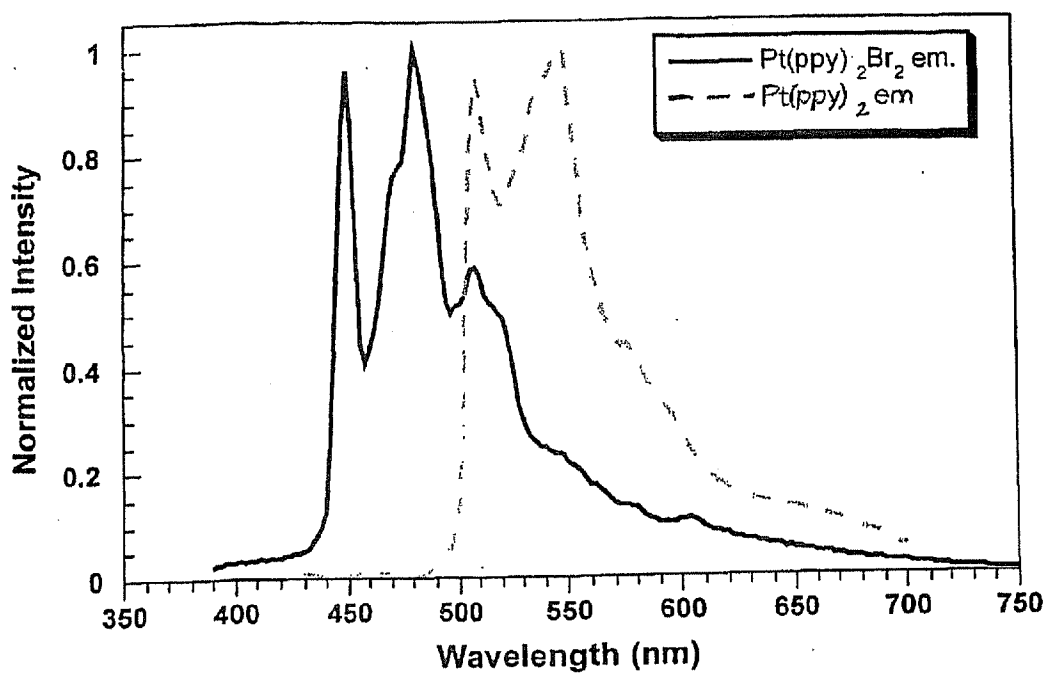


Figure 10

Figure 11: This plot shows the emission spectra of (ppy)AuCl₂ and (ppy)Au(2,2'-biphenylene). Both emit from ligand triplet π - π^* transitions.

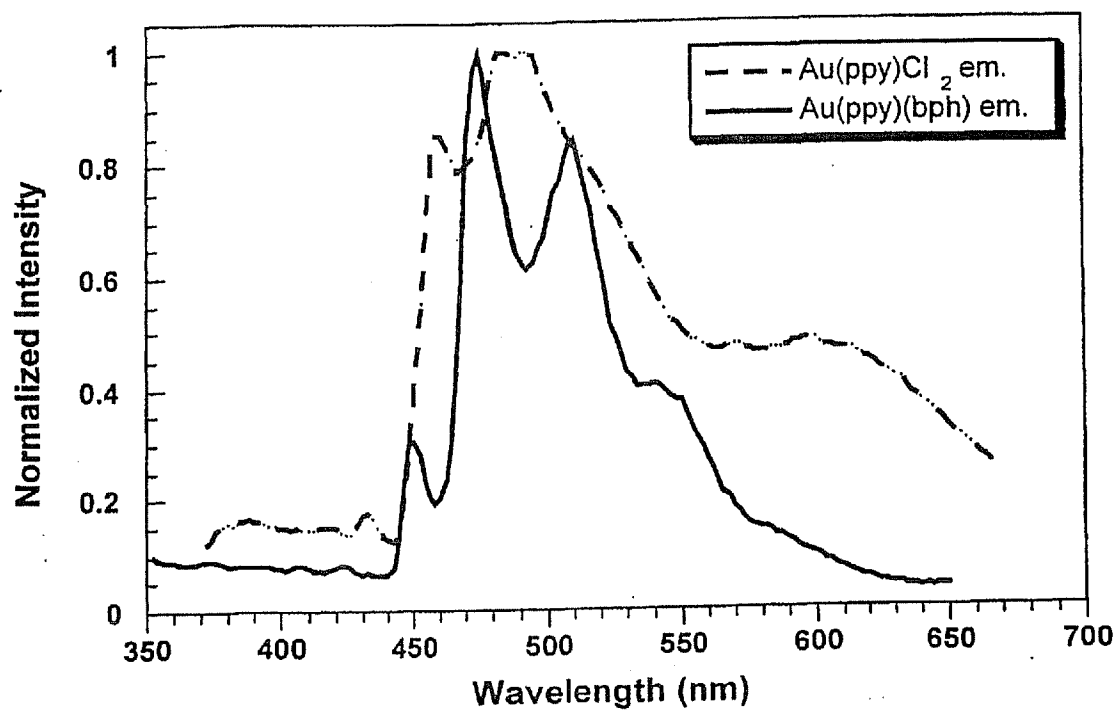


Figure 11

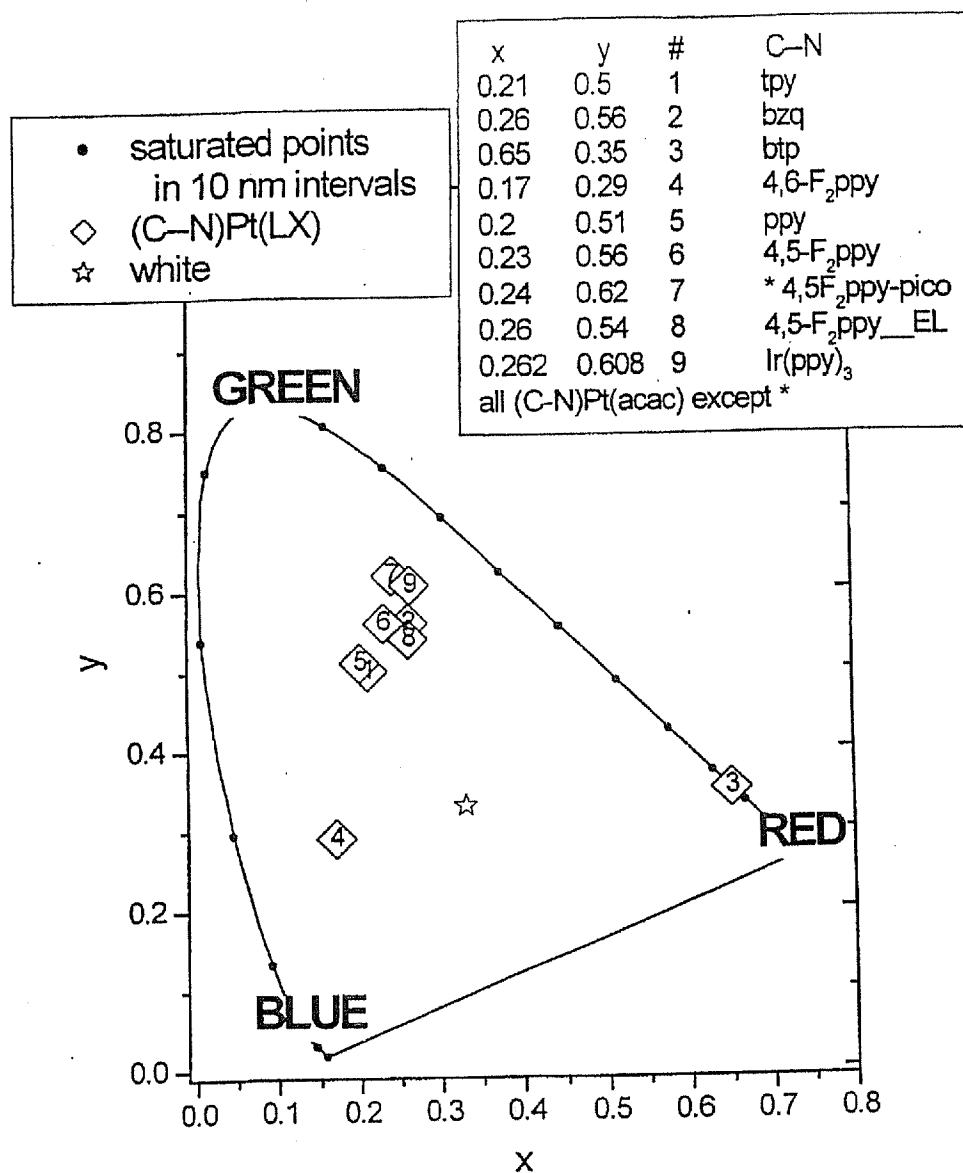


Figure 12

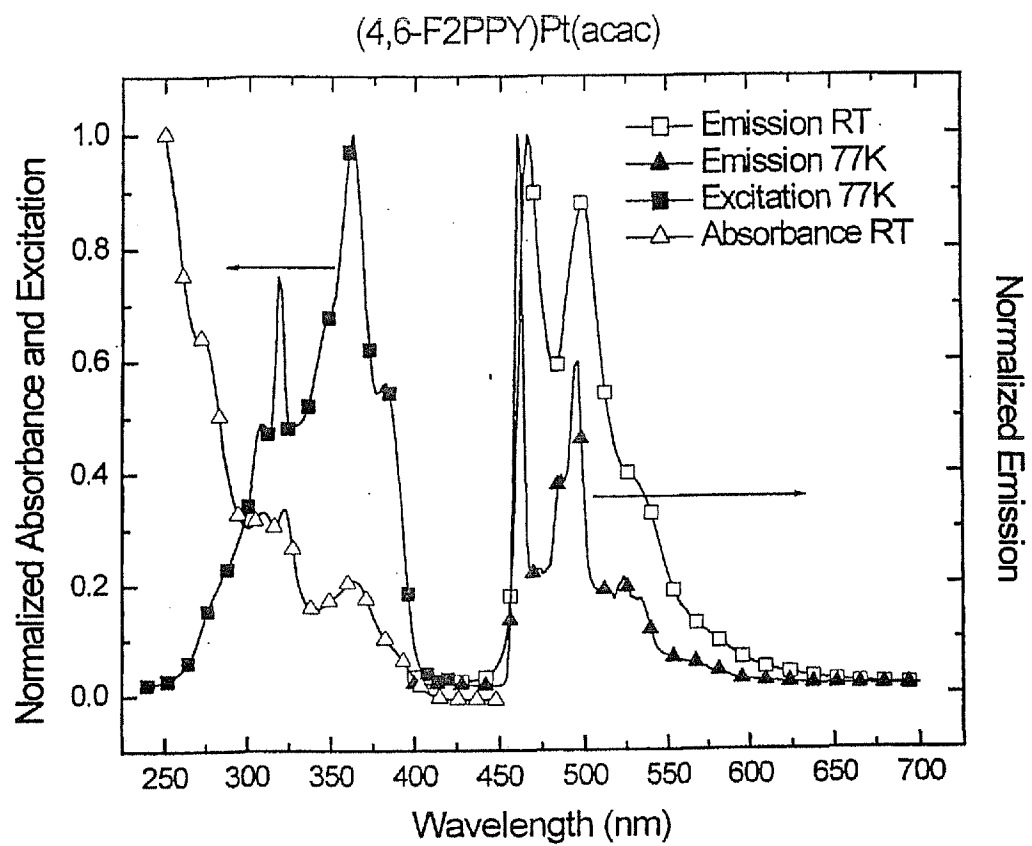


Figure 13

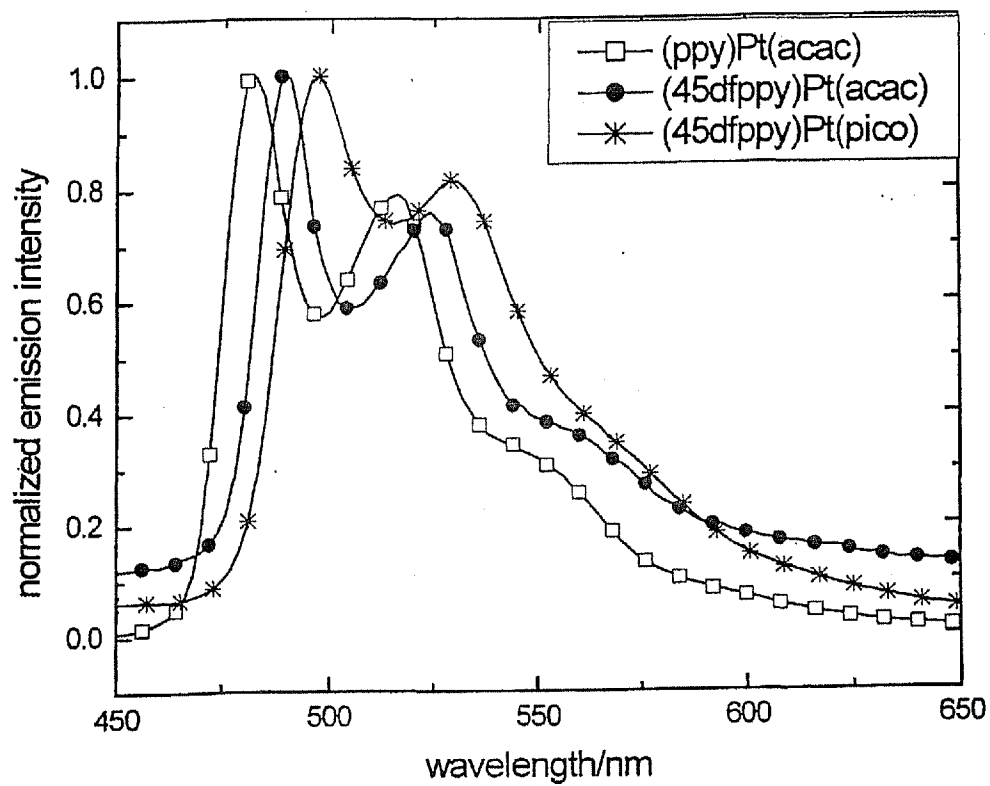


Figure 14

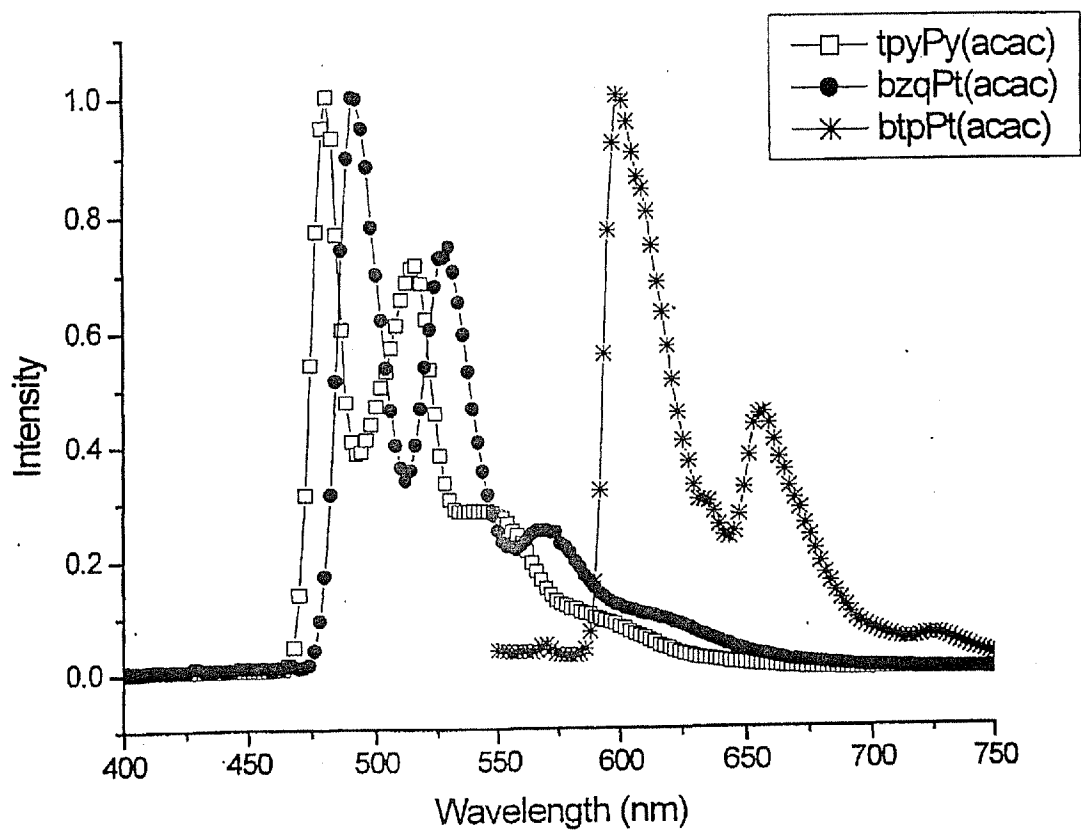


Figure 15

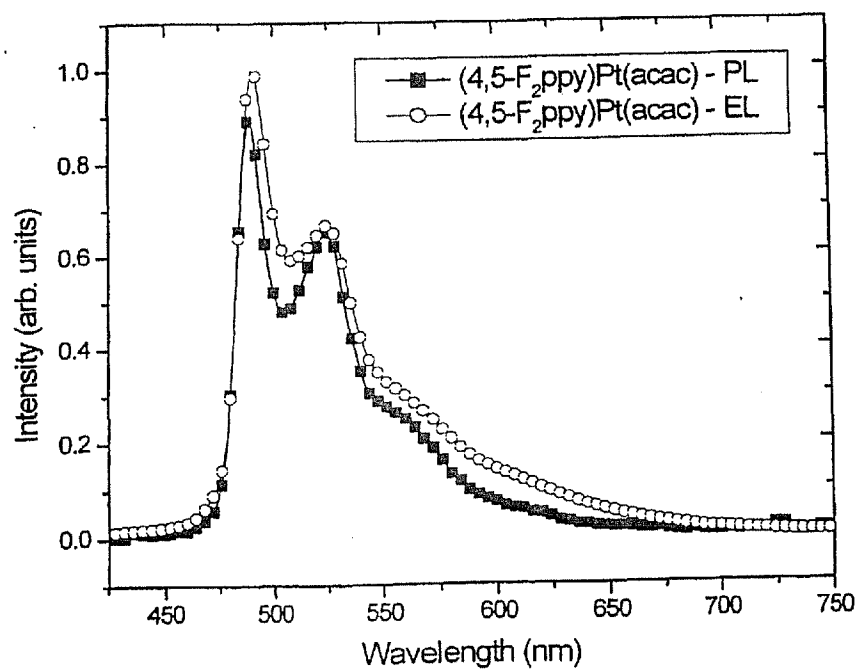
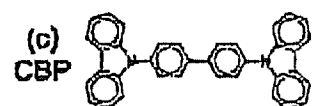
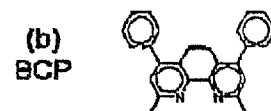
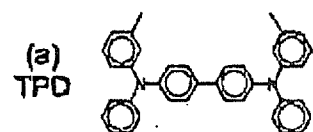


Figure 16

FIG. 17

PRB 62

HOSTS



GUESTS

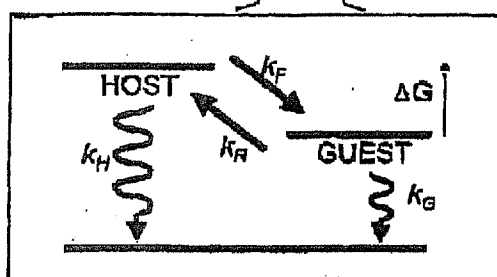
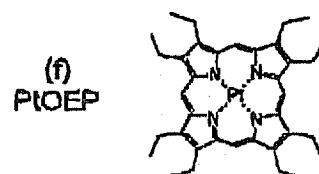
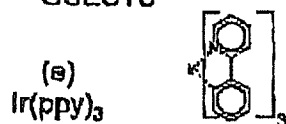


FIG. 18

PRB 62

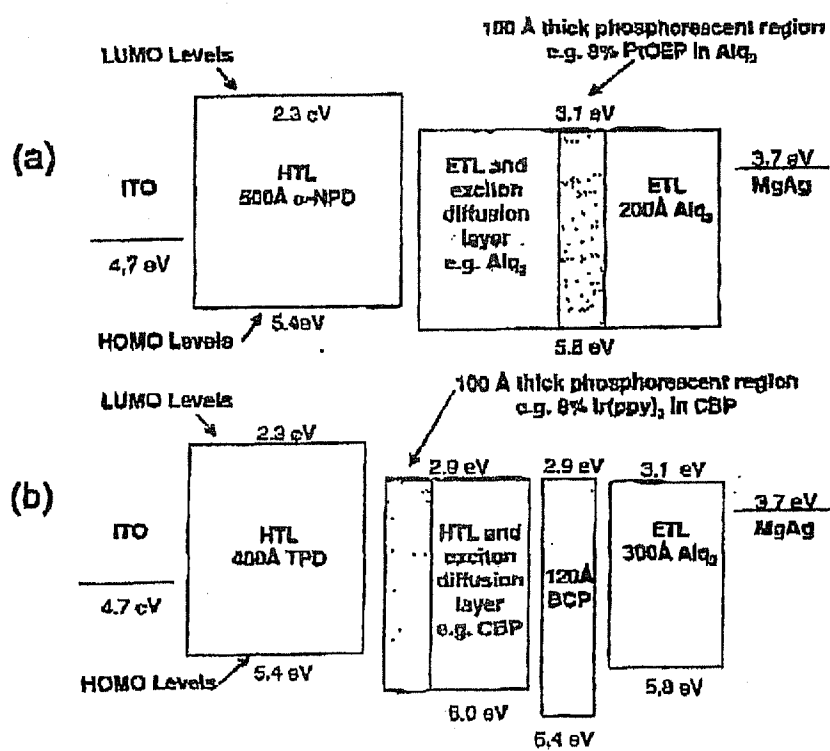


FIG. 19

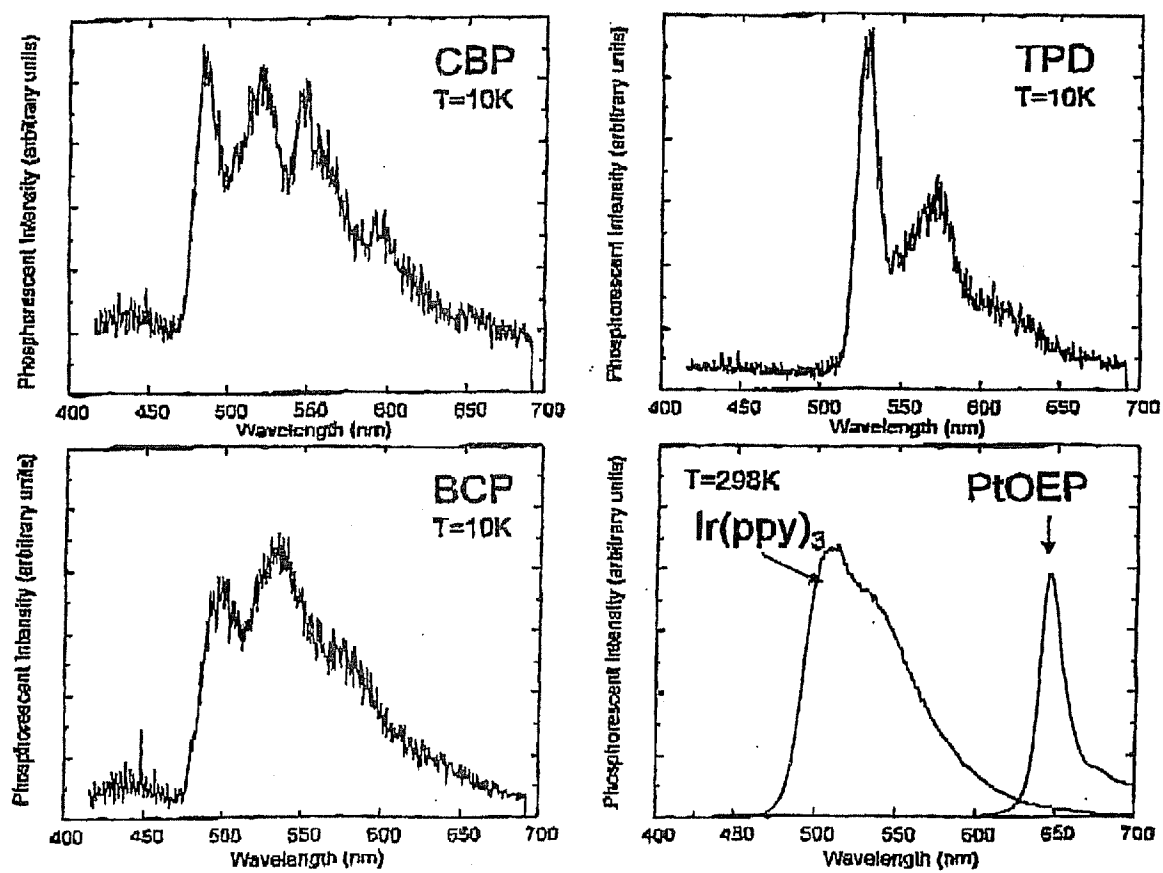


FIG. 20

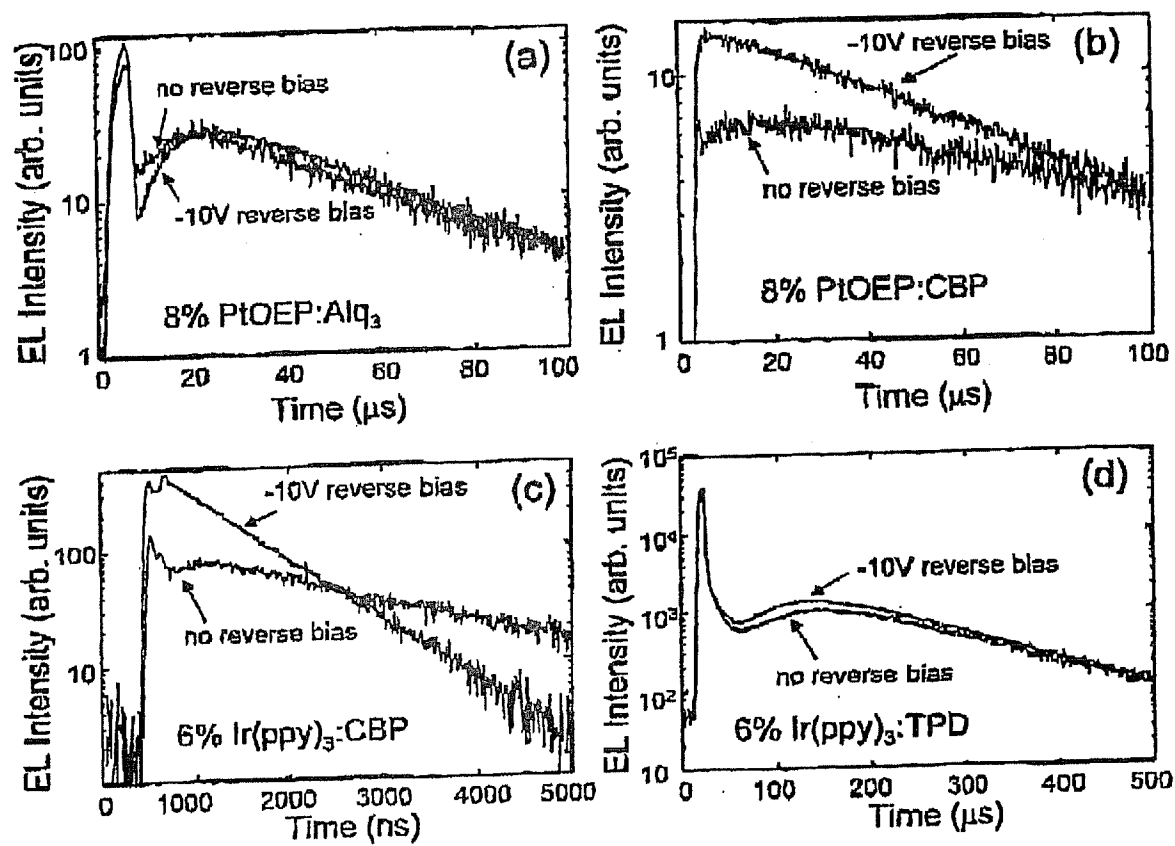


FIG. 21

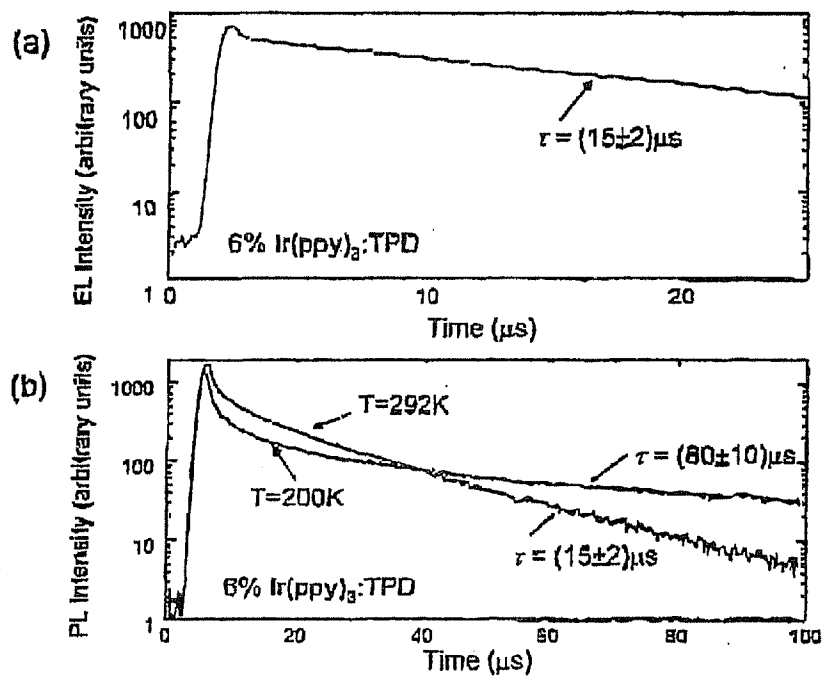


FIG. 22

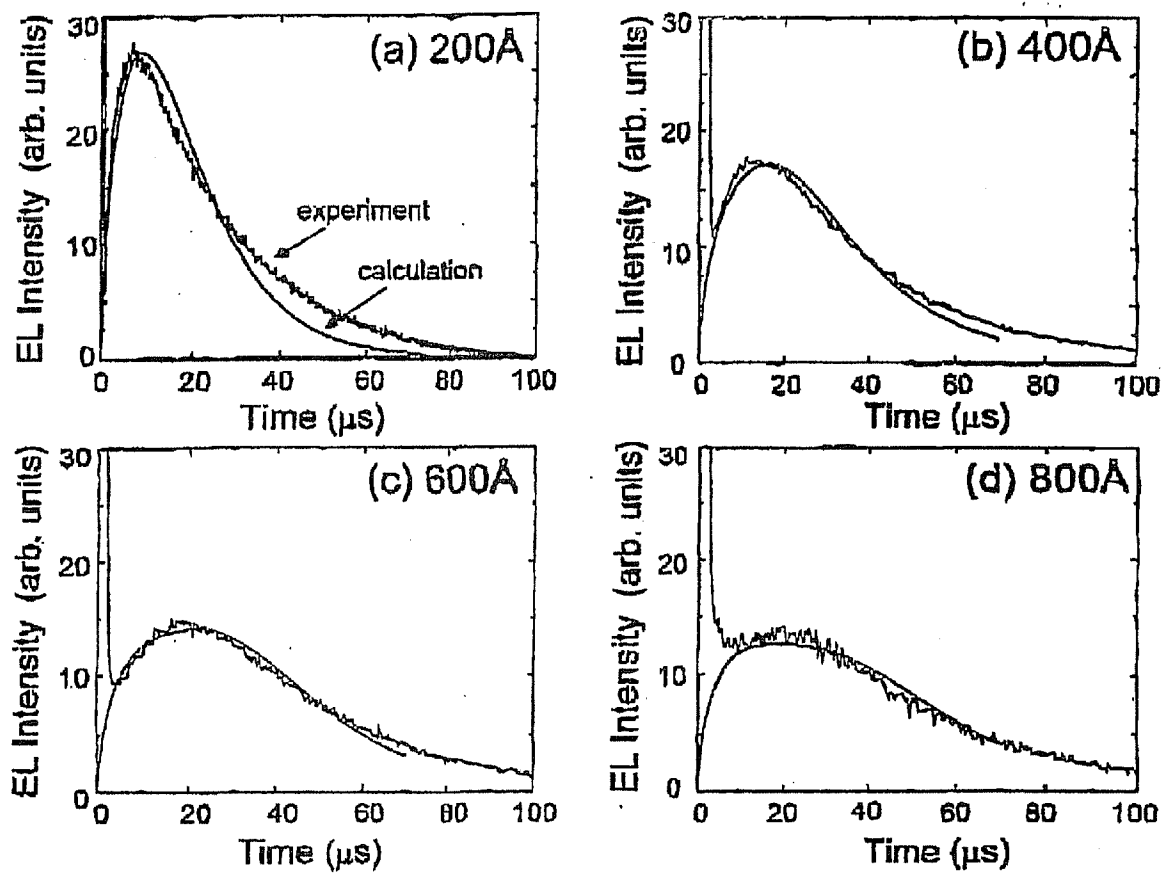
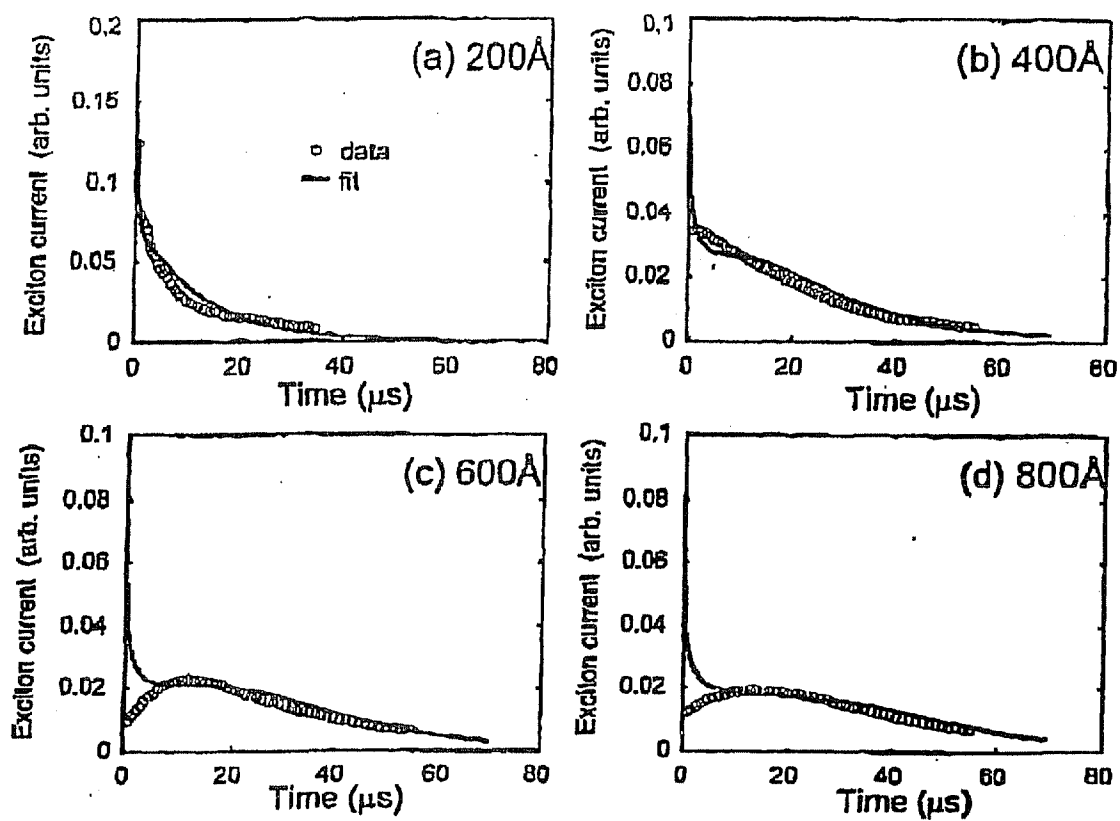


Fig. 23



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/25108

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H05B 33/14; C09K 11/06; C07D 213/02, 231/10, 241/10, 333/52

US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 428/690, 917; 313/504, 506; 257/102; 252/301.16; 544/225, 336; 546/2, 4; 548/101, 103, 365.1, 373.1; 549/3, 49

Documentation searched other than minimum documentation to the extent that such documents are included in the fields
~~searched~~

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BALDO et al. Highly efficient phosphorescent emission from organic electroluminescent devices. Nature. 10 September 1998, Vol. 395, pages 151-154.	1-30
A	BALDO et al. Very high-efficiency green organic light-emitting devices based on electrophosphorescence. Applied Physics Letters. 5 July 1999, Vol. 75, No. 1, pages 4-6.	1-30
A	BALDO et al. High-efficiency fluorescent organic light-emitting devices using a phosphorescent sensitizer. Nature. 17 February 2000, Vol. 403, pages 750-753.	1-30



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"G" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

29 OCTOBER 2001

Date of mailing of the international search report

28 NOV 2001

Name and mailing address of the ISA/US
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Box PCT
Washington, D.C. 20231

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Authorized officer

MARIE R. YAMNITZKY

Telephone No. (703) 808-0651

PCT/US01/25108
PAPALEGAL SPECIALIST
[Signature]

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/25108

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	VON ZELEWSKY et al. Tailor made coordination compounds for photochemical purposes. Coordination Chemistry Reviews. 1994, Vol. 132, pages 75-85.	1-30

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/26108

A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

428/690, 917; 313/504; 257/102; 252/301.16; 544/225, 336; 546/2, 4; 548/101, 103, 365.1, 373.1; 549/3, 49

B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

EAST

search terms: phosphores\$, chelat\$, ligand, organometal\$3, metal\$1organ\$4, coordinat\$5, complex\$5, transition, metal, platinum, pt, iridium, ir, osmium, os